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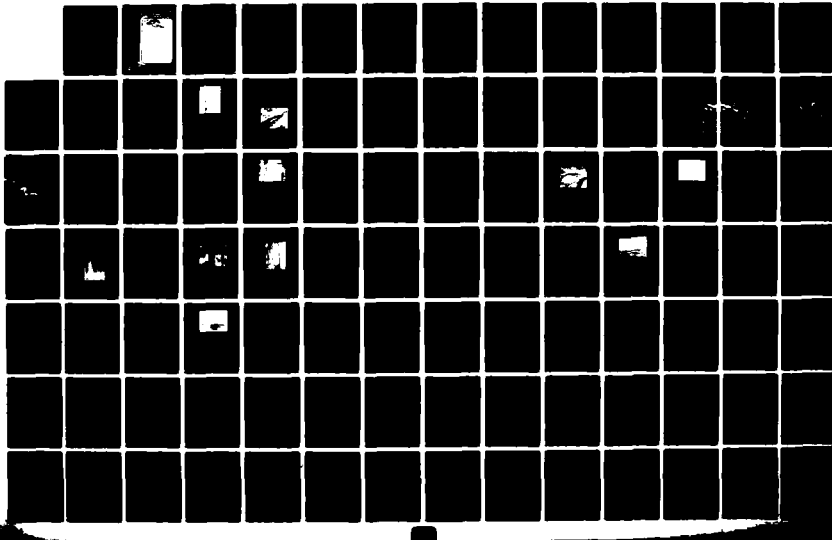

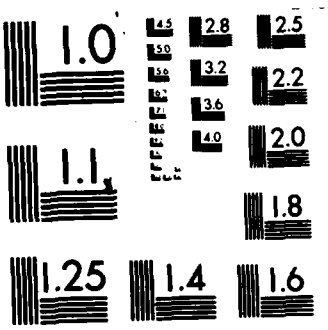

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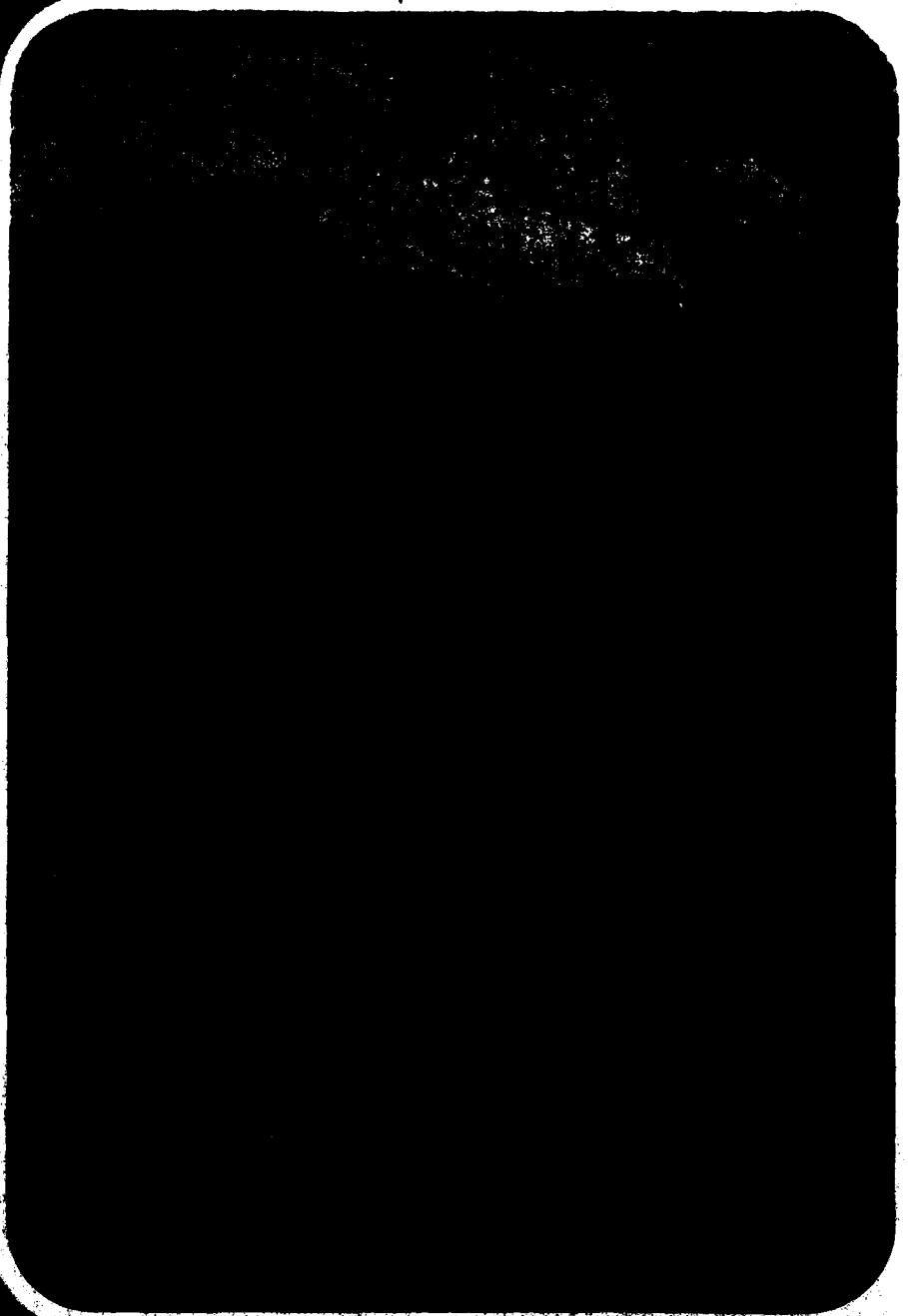

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Detailed inventory of wildlife and management alternatives. Special attention has been given elk ecology and their use of Mud Mountain Dam project lands. Also examines characteristics and relative wildlife value of snags created by the 1974 test pool and provides management recommendations appropriate with regard to wildlife potential. Essential habitats have been noted. Management guidelines are presented to preserve critical habitat and to improve marginal habitat. Interpretive opportunities are also discussed.

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MUD MOUNTAIN WILDLIFE INVENTORY AND HABITAT ANALYSIS

by

Chris Boyd Brewer

DANIEL A. FRYBERGER
DOUGLAS R. BAILEY
KENNETH G. KNOUF

COMMITTEE MEMBERS

Seattle District
U. S. Army
Corps of Engineers

January, 1979

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A-1

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENT	ii
TABLE OF CONTENTS	iii
INTRODUCTION	1
ECOLOGICAL CONCEPTS AND TERMS	2
THE MUD MOUNTAIN DAM ENVIRONMENT	3
THE DAM PROJECT	3
THE RIVER	5
GEOLOGY AND LANDFORMS	6
CLIMATE	8
WILDLIFE INVENTORY	9
ENDANGERED SPECIES	9
POPULATION ESTIMATES	11
WILDLIFE HABITAT REQUIREMENTS	12
WILDLIFE HABITAT ANALYSIS	13
FOREST ECOSYSTEM	13
FOREST HABITAT	18
LOGS	19
MANAGEMENT OF FOREST HABITAT	20
WETLAND ECOSYSTEM	21
IMPORTANCE TO WILDLIFE	24
MANAGEMENT OF WETLANDS	24
INTERPRETIVE POTENTIAL	25

PAGE

RIPARIAN ECOSYSTEMS 26

IMPORTANCE TO WILDLIFE. 27

SNAGS 28

SNAG ECOLOGY. 29

IMPORTANCE TO WILDLIFE. 32

SNAGS AT MUD MOUNTAIN DAM 32

MANAGEMENT OF SNAGS 34

INTERPRETIVE POTENTIAL. 38

ELK 38

HISTORY 38

ELK ECOLOGY 38

THREE SISTERS-GRASS MOUNTAIN ELK. 40

MANAGEMENT OF ELK 43

PREDICTION OF WILDLIFE RESPONSE TO MANAGEMENT ACTIONS 44

CONCLUSIONS WITH SUMMARY OF KEY RECOMMENDATIONS 46

EXHIBITS. 48

REFERENCES CITED. 88

EXHIBITS

		PAGE
EXHIBIT A	TAXONOMY, SEASONAL OCCURRENCE AND RELATIVE ABUNDANCE OF WILDLIFE SPECIES OBSERVED AT MUD MOUNTAIN DAM AND INHABITING WESTERN WASHINGTON IN HABITATS FOUND ON PROJECT LANDS.	49
EXHIBIT B	LIFE FORM AND CONSUMER CLASS OF SPECIES BREEDING AT MUD MOUNTAIN DAM.	71
EXHIBIT C	SPECIES ORIENTATION TO SUCCESSIONAL STAGES.	80
EXHIBIT D	WILDLIFE USE OF RIPARIAN AND WETLAND ECOSYSTEMS.	85

FIGURES

FIGURE NUMBER		PAGE
1	LOCATION OF MUD MOUNTAIN DAM.	3
2	WHITE RIVER WATERSHED	5
3	WESTERN HEMLOCK SUCCESSIONAL STAGES	15
4	RIPARIAN ZONE CHARACTERISTICS	26
5	SNAG SUCCESSION CHARACTERISTICS	29
6	THREE SISTERS - GRASS MOUNTAIN AREA	41

TABLES

TABLE NUMBER		PAGE
1	RARE, ENDANGERED, AND SIGNIFICANT SPECIES	10
2	VERTEBRATE LIFE FORMS	12
3	PLANT COMMUNITIES AND SUCCESSIONAL STAGES	14
4	ANTICIPATED CHANGES IN STRUCTURAL APPEARANCE OF FOREST COMMUNITIES DUE TO MANAGEMENT ACTIONS.	19
5	WILDLIFE USE OF LOGS.	20
6	PLANT SPECIES OBSERVED IN THE LARGE MARSH	23
7	BIRD AND MAMMAL USE OF SNAGS.	33
8	SNAG SPECIES PRESENT AT MUD MOUNTAIN DAM.	33
9	WOODPECKER TERRITORY SIZE AND NUMBER OF CAVITIES USUALLY EXCAVATED BY SPECIES	35
10	SNAG NUMBERS NEEDED TO MAINTAIN WOODPECKERS AT VARIOUS POPULATION LEVELS.	35
11	ELK SEASONAL HABITAT AND FOOD PREFERENCES	39
12	PLANT SPECIES USED AS ELK FORAGE.	42

PHOTOGRAPHS

PHOTOGRAPH NUMBER		PAGE
1	UPPER PORTION OF WHITE RIVER.	6
2	CHANNELIZED WHITE RIVER	7
3	OLD-GROWTH FOREST HABITAT	17
4	LARGE MARSH	22
5	BEAVER LODGE IN THE LARGE MARSH	24
6	SNAG PATCHES.	28
7	NESTING CAVITY IN A SNAG.	30
8	OLD DECAYED SNAG.	31
9	SNAGS IN A POND	37
10	ELK AT HOWARD A. HANSON DAM	44

PLATES

		LOCATION
PLATE 1	UNIQUE HABITAT MAP	After Page 13
PLATE 2	VEGETATION MOSAIC	After Page 13

INTRODUCTION

In 1976, a Master Plan and accompanying Fish and Wildlife Management Plan for the Mud Mountain Dam project were prepared for the Seattle District, U. S. Army Corps of Engineers. While the plans contained extensive information on fish and wildlife species, recommendations were made for a more detailed inventory of wildlife, wildlife habitats, and management alternatives. In an attempt to obtain this information, a 12-week internship was funded by the Corps of Engineers through the Western Interstate Commission for Higher Education. This report is the final product of that effort.

It is the goal of this study not only to provide the Corps of Engineers with information as to the presence of wildlife species and a determination of ecosystem types, but also to impart information on wildlife habitat requirements and response to habitat conditions. With this information, it then becomes possible to predict wildlife responses to management actions.

Special attention has been given to elk ecology and their use of Mud Mountain Dam project lands. In addition, this study examines the characteristics and relative wildlife value of snags created by the 1974 test pool, and provides management recommendations appropriate with regard to their wildlife potential.

Throughout the report, essential habitat areas have been noted. Management guidelines which would preserve critical habitat, alleviate disturbances to wildlife, and improve marginal habitat are presented. Interpretive opportunities provided by special habitat areas are also discussed.

ECOLOGICAL CONCEPTS AND TERMS

It is necessary for certain ecological concepts to be understood for full comprehension of the information supplied within this report. A brief summary of some basic ecological concepts and terms is presented here.

The environment is composed of all physical and biological components of an area, and the study of the interrelationships of these components is incorporated into the comprehensive science of ecology. The living organisms within the environment (plants and animals) in conjunction with the non-living environment (water, minerals, air) form functional units of distinct character called ecosystems.

Plant communities within an ecosystem are created from the combination of existing physical features within that ecosystem. As plant communities grow and develop over time, an orderly process of change in their composition and structure occurs. This change is called succession. Two forms of ecological succession are recognized, primary and secondary. In primary succession, the plant community establishes itself on bare ground or rock. In areas where a previous community has been removed (as in logging or fire), the secondary succession of a new plant community occurs. Successional or seral stages have been recognized based on characteristic structural patterns. The ultimate end of successional change is the development of a climax community which is in equilibrium with the physical conditions and for which no replacement community is apparent. Areas of transition between two or more diverse plant communities are called ecotones. The "edge-effect" is a phenomena of increased plant and animal variety and density observed within ecotones.

Animals require three basic elements for survival: food, water and cover. The availability of these elements and their occurrence in time and space determine an animal's selection of a place to live, or habitat. Animals which feed upon plants are called herbivores, those which feed upon other animals are carnivores, and omnivores are those which feed on both plant and animal matter. These designations are called consumer classes and are consistent among animals of the same species. The various populations of species within an ecosystem form a unique community with a definitive organization of consumer classes. This complex pattern of feeding habits is referred to as a food web. The size of an animal population will increase until some aspect of its survival requirements is no longer abundantly available. This particular aspect is called a limiting factor for that population and the carrying capacity of the ecosystem for that animal species has been reached when a limiting factor stabilizes population growth.

The essential characteristic of ecology was simply expressed once by John Muir who said: "When we try to pick out anything by itself, we find it hitched to everything in the universe."

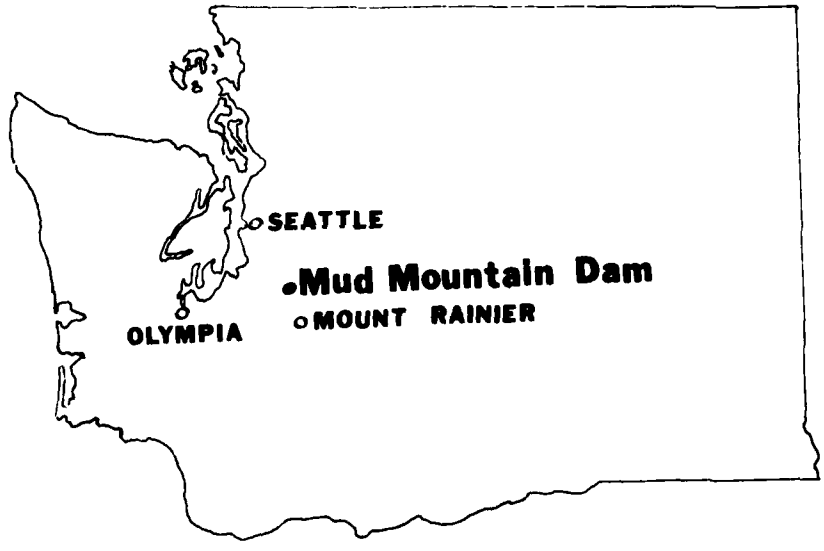
WILDLIFE INVENTORY AND HABITAT ANALYSIS

THE MUD MOUNTAIN DAM ENVIRONMENT

THE DAM PROJECT

Mud Mountain Dam is situated on the western edge of the Cascade Mountains in the approximate location shown in Figure 1. The dam exists for the purpose of regulating flood waters for the Puyallup and lower White River valleys. Construction of the earthen and rockfill dam was begun in 1937 in a narrow gorge of the White River. Halted in 1943 due to wartime activities, construction was resumed in 1947 and the dam was completed in 1953.

Figure 1. Relative location of Mud Mountain Dam in Washington.



The project lands originally acquired by the Federal Government consisted of 2,350 acres. In 1960, it was determined that only 1,640 acres were essential to the dam's operation, and the remainder of the lands was transmitted by quit claim deed to the University of Washington and King County. Presently, the damsite and appurtenant structures occupy 148 acres, with the remaining 1,492 acres in reservoir lands.

The flood control activities do not require the maintenance of a pool behind the dam. During heavy rain or runoff, however, the discharge is regulated to limit the flow of the lower White and Puyallup Rivers to designated volumes. At this time, the water behind the dam rises from its usual river level of approximately 950' to 990' above mean sea level (msl). Historically, the flood pool elevations attain yearly heights of 1080' msl and occasionally 1096' msl. The 50 and 100 year floods are estimated to cause elevation rises up to 1130' and 1152' msl, respectively. Debris, removed yearly from the dam area, is transported upstream to one of two basins (upper or lower), located on the northern shore of the river, and burned every fall. Pool elevations of 1050' msl are required for debris to be transported.

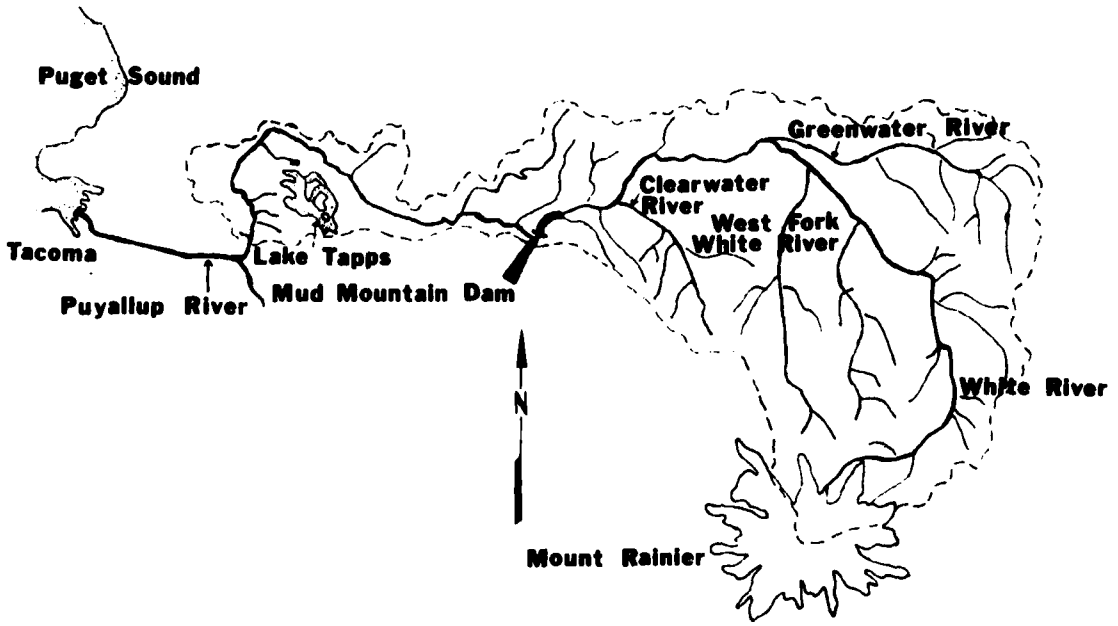
In 1974, a test pool was maintained to determine indications of seepage through the construction material. During this time, the water level rose as high as 1150' msl and was maintained at 1130' msl for a period of approximately two months (5).* Evidence of vegetation alterations at this water level is prevalent throughout the project lands.

Access to project lands is limited. The surrounding lands, with the exception of those deeded to the University of Washington and King County, are owned by the Weyerhaeuser and St. Regis timber companies, who maintain roads through land contiguous with Mud Mountain project lands. Permission is granted to the U. S. Army Corps of Engineers for access to the upper and lower basins and the fish dumping facilities located on the northern side of the White River. Access on the southern shore can only be accomplished by crossing the top of the dam and continuing by foot, or by obtaining permission from St. Regis to walk from its roads into the project.

The construction of a rim trail, open for public use, is partially completed. The trail, when finished, will parallel the river on both sides, crossing it on the upstream end of the project. Existing public use facilities include a picnic shelter, playground equipment, and restrooms.

*Footnote numbers refer to references cited at the end of this report.

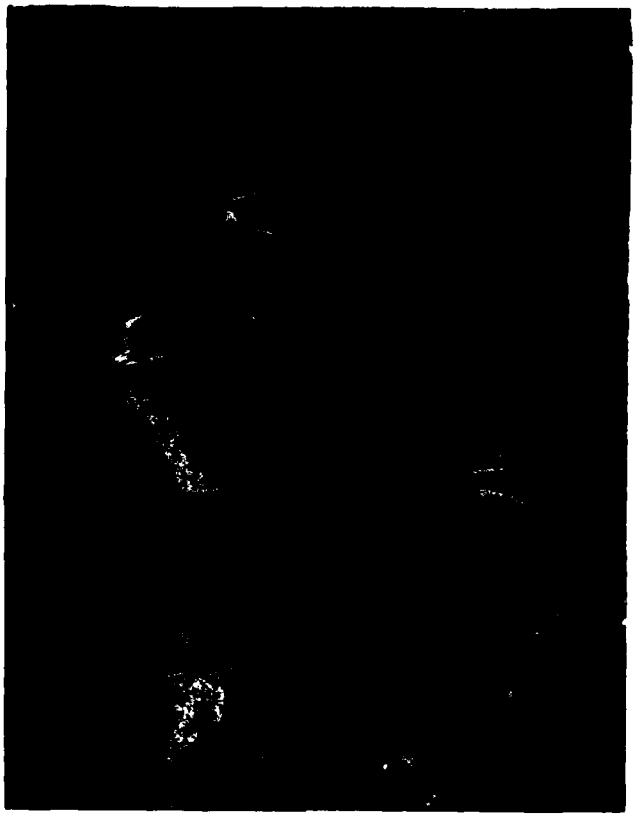
Figure 2. White River Watershed.



THE RIVER

The White River is a major tributary in the Puyallup River watershed which eventually drains into Puget Sound near Tacoma, Washington (see Figure 2). Originating as glacial meltwater from Mount Rainier, water in the White River is highly turbid from very fine rock particles called "glacial flour," formed by glacial movements. The upper portion of the 5.5 miles of river which bisects project lands is a typical braided river with numerous sand and gravel bars. The lower portion becomes channeled as it approaches the White River Gorge, across which the dam is now built. River flow is diverted around the dam by tunnels passing through the right abutment.

Several streams and a major tributary, the Clearwater River, join the White River within project lands. These waters are created from snowmelt and winter rains.



Photograph 1

The upper portions of the White River on project lands are characteristic of a braided river and undisturbed by dam opertions.

GEOLOGY AND LANDFORMS

Mud Mountain Dam is situated on the western border of the Cascade Mountains. The surrounding relief is characterized by smoothly rounded mountains and ridges, such as Mud Mountain, for which the project is named.

The geology of the area has been greatly affected by glacial and fluvial processes. Initially formed as a broad valley during the Cascade uplift, a series of fillings caused by glacial deposits, mud flows, and river sediment deposition were countered by fluvial erosional processes to form a narrow river valley.

The project lands can be divided into four distinct areas based on topography, geomorphology, and geology:

1. Inner valley floor
2. South valley slope
3. North valley slope
4. Upland areas

The lower inner valley floor is subject to the dynamics of river processes. The pattern of river flow in the braided portions of the river periodically shift. Gravel, boulders and sand are deposited throughout by the White River. In the wider segments of the inner valley, a low valley terrace, approximately 20 feet above the river, forms much of the valley floor. The terrace is composed of flood-related silt and sand, and is subject to erosion along the river margin.

Photograph 2

River flow becomes channelized as the White River approaches the dam. The steep valley slopes and high disturbance from dam activities inhibits the development of a riparian community.

The south valley slope contains grades generally steeper than 30 percent and often reaching 50 percent. Sandy, silty colluvium covers the slopes, beneath which lies a sequence of gravel, boulders, sand, clays, silts, and mudflow materials. Prolonged heavy rainfall and reservoir drawdown have initiated landslides in portions of the valley wall. Volcanic bedrock is exposed within a small gorge in the vicinity of Old Pond Creek and also occurs upstream from Canyon Creek, where it is covered with varying thicknesses of colluvium.

The north valley slope is composed primarily of outwash and mudflow materials. A mantle of thick colluvium covers the majority of the area. Slopes are generally greater than 50 percent, often reaching 70 percent in areas where the colluvium has sloughed away and 90 percent in the vicinity of the dam and between the upper and lower debris basins. Landslides have occurred in the past along these slopes. Perched water tables on ancient lakebeds have created several springs along the north valley wall (5).

Upland areas consist of varying widths of land where the north and south valley walls have leveled off to declivities less than 15 percent. Substratum compositions are consistent with those found in the valley slopes.

CLIMATE

The climate in the Mud Mountain vicinity is typical of the Pacific maritime climate, represented by mild winters and cool summers. Dense fog is prevalent throughout much of the year and the average annual precipitation is 53 inches. Three-fourths of the total rainfall occurs in a six-month period from October through March. An average of 15 inches of snow occurs at the damsite. Average temperatures for July range from a low of 51 F to a high of 72 F, while January temperatures average between 31 F and 43 F. Extremes of 99 F and -2 F have been recorded. Prevailing winds blow from the southwest, bringing moist air into the area, while occasional north and northwest winds generally bring clearing (5).

WILDLIFE INVENTORY

The inventory of wildlife at Mud Mountain Dam indicates utilization of the area by 187 species of birds, 54 species of mammals, 7 species of amphibians, and 4 species of reptiles. These species are presented in Exhibit A, which shows the common and scientific names of each species, relative abundance, and seasonal occurrence within the state. Of these, 116 species have been positively identified as inhabitants of project lands (noted by asterisk in Exhibit A). The majority of these were observed by the intern on project lands or local authorities in areas immediately adjacent to project lands (1, 8, 14, 19, 25, 26, 42).

As the field work for this project was conducted during a portion of the summer months, species common to the project during other seasons were not observed. Several distribution works (1, 4, 16, 17, 18) have been used to determine the presence of animals not observed on project lands during this period.

ENDANGERED SPECIES

The Federal Register of Endangered and Threatened Wildlife and Plants contains no listing of species which are residents of project lands. Two endangered species which may migrate through project lands are the Aleutian Canada Goose (Branta canadensis leucopareia) and the American Peregrine Falcon (Falco peregrinus anatum). (11)

There are several species of birds and mammals whose status is either not known, or who appear to be suffering in all or part of their ranges from noncyclical declines. The National Audubon Society compiles a yearly "blue list" of these birds from data contributed by nationwide Audubon chapters. The Washington State Game Department and others have indicated bird and mammal species which are either quite rare, relatively unknown, or very localized and vulnerable to local habitat alteration. Table 1 indicates birds and mammals potentially found on project lands who have been noted by the above organizations as species which should be watched with concern in the state.

TABLE 1

Rare, endangered or otherwise significant birds and mammals found on project lands (2, 40, 41).

BIRDS	
*Western Grebe	Blue-listed, NAS
Trumpeter Swan	Localized species
Canvasback	Blue-listed, NAS
Sharp-shinned Hawk	"
*Cooper's Hawk	"
Golden Eagle	Significant species
Bald Eagle	Threatened
Marsh Hawk	Blue-listed, NAS
Osprey	"
American Kestrel	"
*Barn Owl	"
Northern Spotted Owl	Rare, uncertain status
Great Gray Owl	Rare, uncertain status
Short-eared Owl	Blue-listed, NAS
Common Nighthawk	"
Lewis' Woodpecker	"
*Hairy Woodpecker	"
*Cliff Swallow	"
Purple Martin	"
*Bewick's Wren	"
Yellow Warbler	"
Vesper Sparrow	"
MAMMALS	
Mountain Lion	Rare, Washington Dept. of Game
Bobcat	" "

*Not Blue-listed by Pacific Northwest correspondents

POPULATION ESTIMATES

For the purpose of this report, three animal populations have been quantified: deer, elk, and bear. A discussion of the elk population can be found in the special section on elk.

Accurate determinations of deer population numbers require prolonged use of population estimation techniques such as deer pellet group transects. A reasonable estimate of the present deer population, however, can be made based upon summer pellet group counts and Forest Service population estimates for the White River District (8). These indicate that a healthy resident population of approximately 50 deer inhabit project lands. Animal trails are prevalent throughout the area and deer use is evenly distributed.

Bears have relatively large territorial requirements and generally establish and maintain territories for extended time periods. Bears using Mud Mountain Dam lands most likely have territories which extend to surrounding lands. Two bears have been observed on the project and it may be possible for a third to occupy portions of the area. However, it is doubtful that more than three bears would be found in the area, except possibly for additional bear cubs. These would remain with their mother(s) until establishment of their own territory elsewhere during their second summer.

WILDLIFE HABITAT REQUIREMENTS

The critical factor in wildlife survival is the presence of adequate habitat. It is important, therefore, to recognize the habitat requirements of individual species and to protect those areas which are essential.

Because of the great numbers of animal species present at Mud Mountain Dam, a grouping of similar habitat-adapted species will aid considerably in the recognition of habitat requirements. The "life-form" concept, originated by A. Haapenen (15) in his work in Finnish forests, divides species into groups based on specific combinations of habitat requirements for feeding and reproduction. This concept has been adapted by Thomas et al (35) into 16 groups, 15 of which are used here. A list of these life form categories may be found in Table 2. Exhibit B, located at the end of the study, consists of species which may reproduce at Mud Mountain Dam organized into their appropriate life form categories.

TABLE 2 Description of vertebrate life forms occurring at Mud Mountain Dam.*

Life Form Number	Reproduces	Feeds
1	In water	On ground, in bushes and/or trees
2	On ground around water	In water, on ground, in bushes and trees
3	In cliffs, caves, rims and/or talus	On ground or in air
4	On ground without specific water, cliff, rim or talus association	On ground
5	On ground	In bushes, trees, or air
6	In bushes	On ground, in water or air
7	In bushes	In bushes, trees, or air
8	Primarily in deciduous trees	In bushes, trees, or air
9	Primarily in conifers	In bushes, trees, or air
10	In trees	On ground, in bushes, trees, or air
11	On very thick branches	On ground or in water
12	Excavates own hole in tree	On ground, in bushes, trees, or air
13	In a hole made by another species or naturally occurring	On ground, in water, or air
14	Underground burrow	On or under ground
15	Underground burrow	In water or air

*Adapted from Thomas et al (35)

It is equally important to understand an animal's relationship to the plants and animals found within its habitat. The designation of an animal's consumer class indicates this relationship in addition to those foods which are essential for the perpetuation of the species. Exhibit B also provides the consumer class designation of each breeding species.

With the above information, considerable insight can be obtained concerning an animal's habitat requirements. Used in conjunction with ensuing information on habitat preferences, the wildlife manager should be able to predict an animal's response to changing habitat conditions.

WILDLIFE HABITAT ANALYSIS

Mud Mountain Dam habitat can be divided into three distinct ecosystems:

1. Forest ecosystem.
2. Wetland ecosystem.
3. Riparian ecosystem.

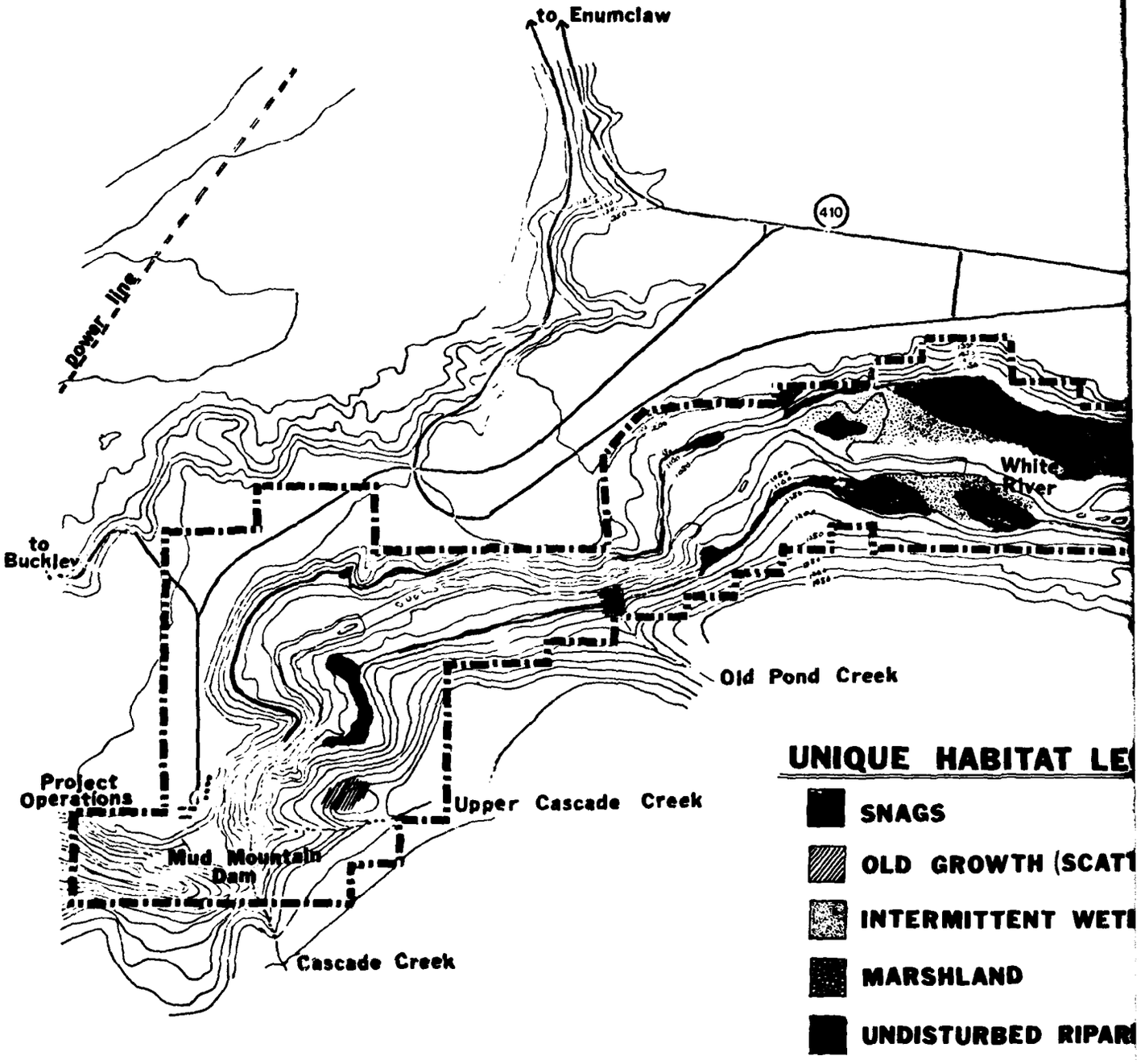
Within each of these ecosystems, several habitat areas are present. Unique habitats within each are identified on the Unique Habitat Map, Plate 1. Locations are approximate, but indicate general locality and extent of habitat areas.

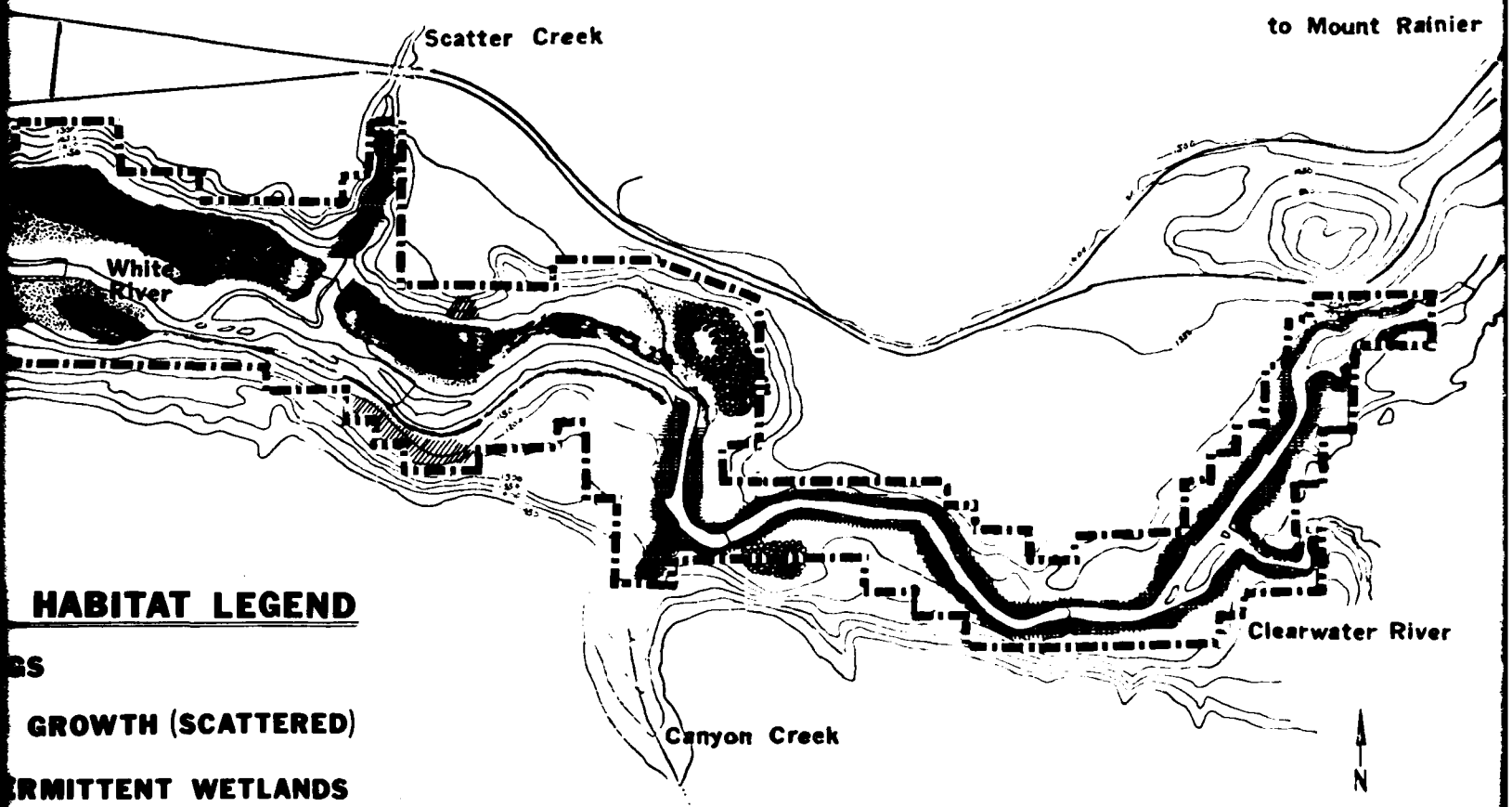
FOREST ECOSYSTEM

Forested areas comprise the majority of the project lands. The composition and structure of the forests vary greatly and produce several different habitat opportunities for wildlife species. A Vegetation Mosaic, Plate 2, prepared for the 1976 Master Plan, indicates the various plant communities present. Table 3 elaborates upon the species composition and structural characteristics of each plant community.

In this region of the Pacific coast, the climatic conditions favor a climax forest community with western hemlock as the dominant tree species. In moist soils, such as those present at Mud Mountain Dam, western red cedar may dominate in conjunction with or over western hemlock.

The riparian nature of the project lands with sandy soils and moist conditions promotes the great diversity of plant communities which prevails. Because of this influence, it is difficult to generalize upon successional patterns. However, a basic description of forest succession in western


to Enumclaw
410
Power line
White River
to Buckley
Old Pond Creek
Project Operations
Upper Cascade Creek
Mud Mountain Dam
Cascade Creek
UNIQUE HABITAT LE
SNAGS
OLD GROWTH (SCAT
INTERMITTENT WET
MARSHLAND
UNDISTURBED RIPAR



HABITAT LEGEND

GS

GROWTH (SCATTERED)

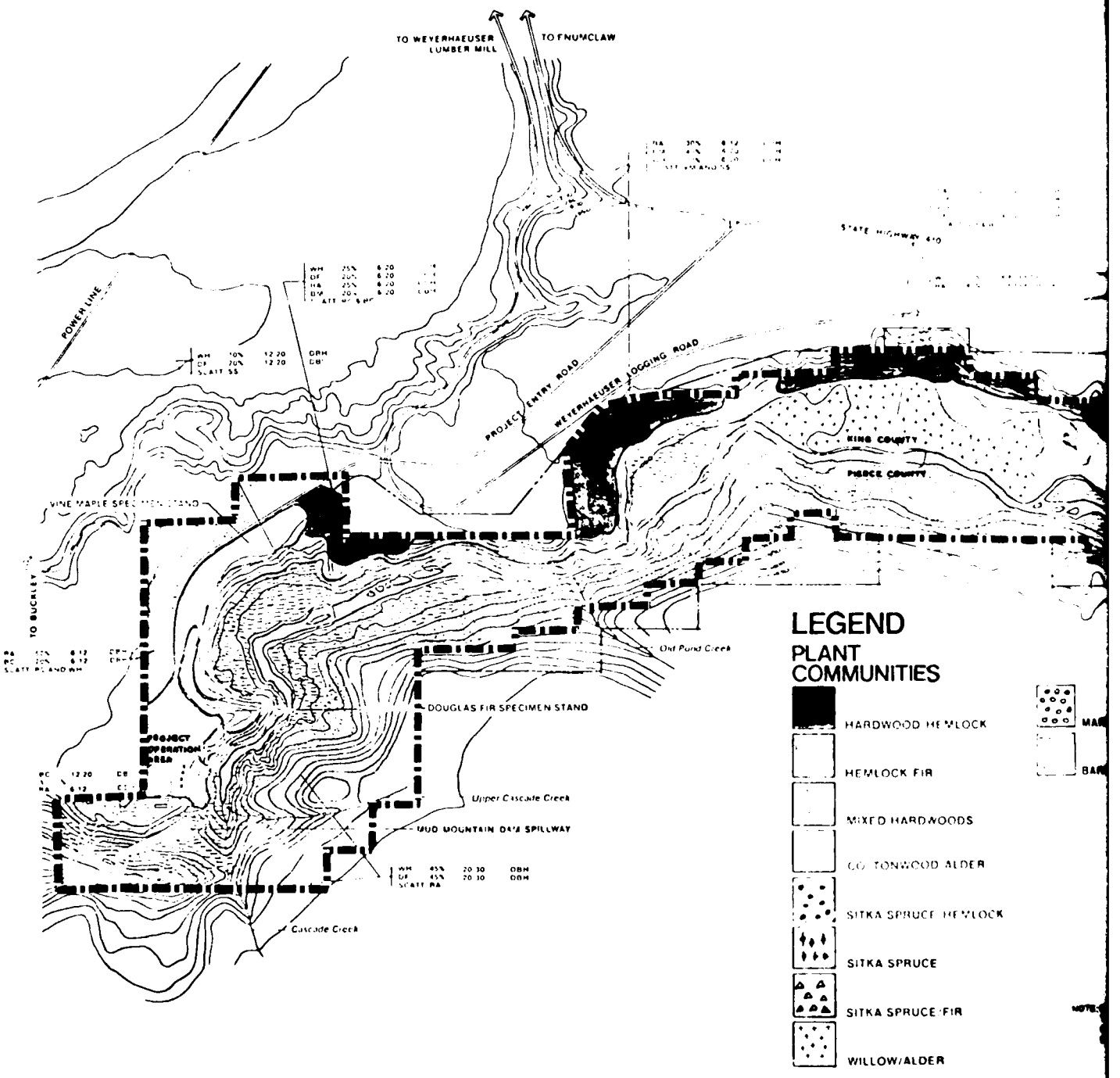
RMITTENT WETLANDS

SHLAND

STURBED RIPARIAN

MUD MOUNTAIN DAM

1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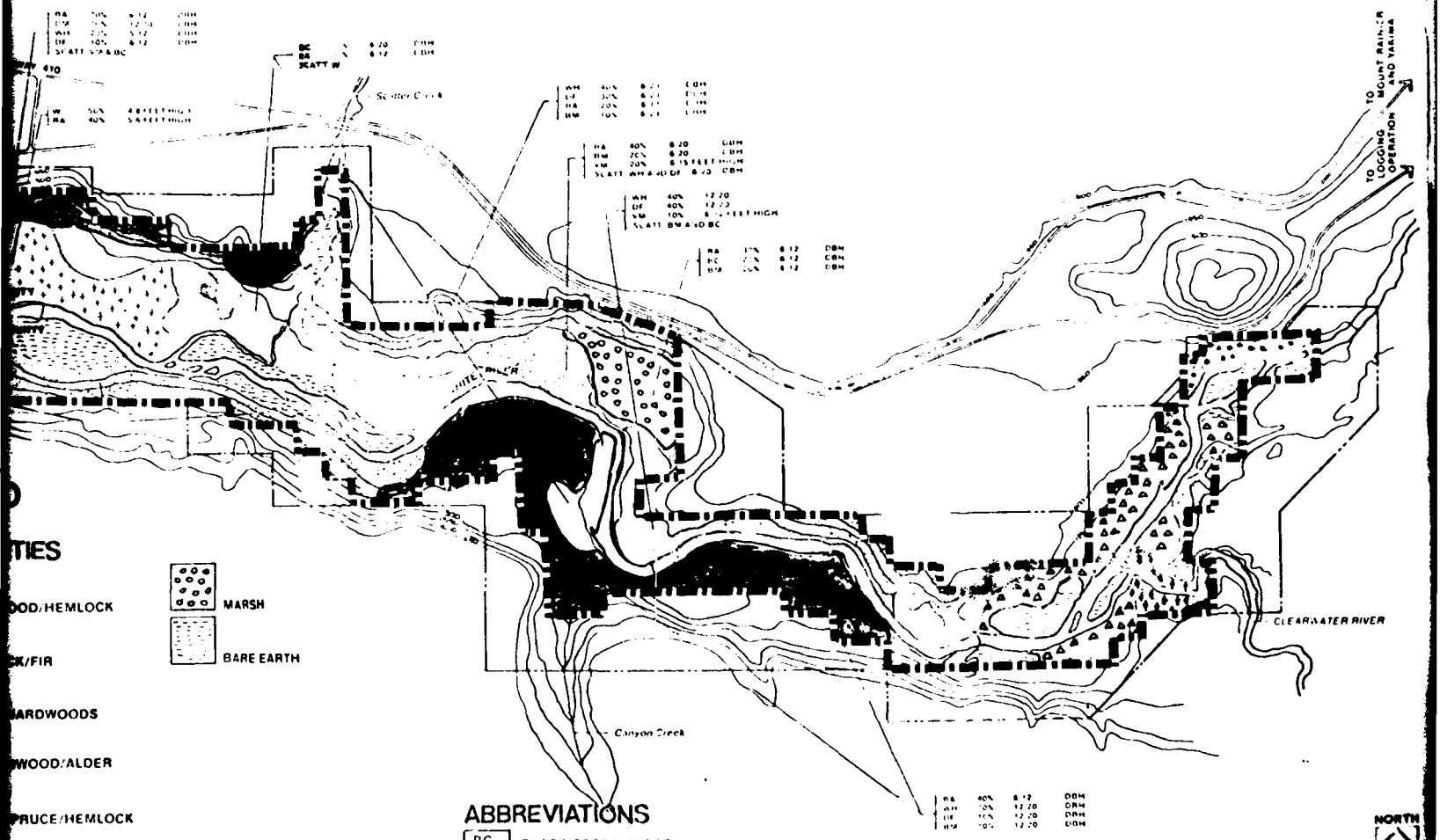
POWER LINE
PROJECT ENTRY ROAD
WEYERHAEUSER LOGGING ROAD
KING COUNTY
PIERCE COUNTY
VINE MAPLE SPECIMEN STAND
TO BUCKLEY
Ont Pond Creek
DOUGLAS FIR SPECIMEN STAND
PROJECT OPERATION AREA
Upper Cascade Creek
MUD MOUNTAIN DAM SPILLWAY
Cascade Creek
LEGEND
PLANT COMMUNITIES
HARDWOOD HEMLOCK
HEMLOCK FIR
MIXED HARDWOODS
COTTONWOOD ALDER
SITKA SPRUCE HEMLOCK
SITKA SPRUCE
SITKA SPRUCE FIR
WILLOW/ALDER



TIES

OD/HEMLOCK

K/FIR

ARDWOODS

WOOD/ALDER

PRUCE/HEMLOCK

PRUCE

PRUCE/FIR

ALDER

MARSH

BARE EARTH

NOTE DBH MEANS – DIAMETER OF TREE MEASURED AT BREAST HEIGHT (APPROXIMATELY FIVE FEET ABOVE THE GROUND).

ABBREVIATIONS

BC	BLACK COTTONWOOD
BM	BIG LEAF MAPLE
DF	DOUGLAS FIR
RA	RED ALDER
RC	RED CEDAR
SS	SITKA SPRUCE
VM	VINE MAPLE
WH	WESTERN HEMLOCK
W	WILLOW

NORTH

0 500 1000 1500 2000 2500 FEET

CONTOUR INTERVAL 50 FEET

MUD MOUNTAIN DAM
WHITE RIVER, WASHINGTON
VEGETATION MOSAIC
2

2

Table 3. Plant communities and estimated successional stages (5)

COMMUNITY	OVERSTORY	UNDERSTORY	COMMENTS	*ESTIMATED SUCCESSIONAL STAGE
Sitka Spruce/Hemlock	Tsuga Heterophylla - western hemlock Picea sitchensis - Sitka spruce	Acer circinatum - vine maple Oxalis oregona - Oregon oxalis Polystichum munitum - sword fern Rubus spectalibis - salmonberry	Semiopen overstory, patchy mixture of spruce and hemlock. Spruce dominates species (60 percent) hemlock, 40 percent of overstory population. Great variations in size. Sitka spruce, largest of specimens, reaches 18 inches DBH. Understory dense, hard to penetrate.	Mature forest.
Sitka Spruce/Fir	Picea sitchensis - Sitka spruce Pseudotsuga menzeisii - Douglas fir	Acer circinatum - vine maple Mahonia nervosa - Oregon grape Gaultheria shallon - Salal	Dense overstory of spruce Douglas fir mixture. Sitka spruce 60 percent of population, fir 40 percent. DBH for both species 12-20 inches. Understory generally open.	Young forest.
Sitka Spruce	Picea sitchensis - Sitka spruce	Acer circinatum - vine maple Oxalis oregona - Oregon oxalis Polystichum munitum - sword fern	Dense, continuous grove, 100 percent Sitka spruce, 6 to 10 feet in height. Both understory and overstory dense.	Young forest.
Willow Alder	Alnus rubra - red alder Salix hookeriana - hooker willow	Grasses	Open overstory, dense tangled understory. Located on lower river terrace, flooded annually. Willow reaches 4-8 feet in height, alder only 4-5 feet.	Seedling shrub.
Mixed Hardwood	Acer macrophyllum - big-leaf maple Alnus rubra - red alder Populus trichocarpa - black cottonwood	Acer circinatum - vine maple Mahonia nervosa - Oregon grape Gaultheria shallon - salal Lotus crassafolius - deervetch Oplopanax horridus - devils club Osmaronia cerasiformis - osoberry Oxalis oregona - Oregon oxalis Polystichum munitum - sword fern Rubus spectabilis - salmonberry Rubus parviflorus - thimbleberry	Overstory semiopen, 80-90 percent hardwoods 6 to 20 inches DBH. Scattered western hemlock and Douglas fir, 6 to 12 inches DBH. Understory open.	Advanced young forest.
Cottonwood/Alder	Populus trichocarpa - black cottonwood Alnus rubra - red alder	Salix hookeriana - hooker willow Grasses	Semiopen overstory dominated by 6 to 20 inches DBH black cottonwood. Area floods annually. Has open understory. Cottonwood in some cases have extended their root systems above ground to compensate for frequent flood conditions.	Young forest.
Hardwood/Hemlock	Acer macrophyllum - big-leaf maple Alnus rubra - red alder Populus trichocarpa - black cottonwood Thuja plicata - western red cedar Tsuga heterophylla - western hemlock	Acer circinatum - vine maple Mahonia nervosa - Oregon grape Gaultheria shallon - salal Oplopanax horridus - devils club Osmaronia cerasiformis - osoberry Polystichum munitum - sword fern Rubus spectabilis - salmonberry Rubus parviflorus - thimbleberry	Semiopen overstory dominated by hardwoods. Overstory population: 30 percent red alder (6 inches diameter breast height (DBH), 20 percent hemlock, remaining 50 percent mixed hardwoods. Understory open except for occasional brush tangles.	Advanced young forest.
Hemlock/Fir	Pseudotsuga menzeisii - Douglas fir Tsuga heterophylla - western hemlock Thuja plicata - western red cedar	Acer circinatum - vine maple Magonia nervosa - Oregon grape Gautheria shallon - salal Holodiscus discolor - cream bush oceanspray Oplopanax horridus - devils club Osmaronia cerasiformis - osoberry Polystichum munitum - sword fern Trientalis latifolia - starflower	Dense overstory dominated by hemlock. Overstory population: 50 percent hemlock (12 to 20 inches DBH, 20 to 30 percent Douglas fir, remaining overstory mixed hardwoods. Understory varies from open to dense brush tangles.	Mature forest.

*Personal estimations of approximate successional stages of each plant community.

hemlock-dominated forests will provide an insight into present and future development of the forest ecosystem at Mud Mountain Dam.

With the exception of scattered old growth (reference Unique Habitat Map, Plate 1), all areas at Mud Mountain Dam have been previously logged and the present forest is second growth timber. The successional pattern is therefore secondary succession. A simplified diagram of secondary succession is presented in Figure 3. Six seral stages are recognized: grass-forb, shrub-seedling, pole-sapling, young forest, mature forest, and old growth. Various characteristics of the seral stages are indicated in Figure 3, as well as the approximate time intervals for each stage.

FIGURE 3. Generalized western hemlock forest successional stages and relative environmental characteristics. (The number of Xs indicates the relative magnitude.)

	SUCCESSIONAL STAGES					
CONDITIONS	Grass-forb	Shrub-seedling	Pole-sapling	Young Forest	Mature Forest	Old Growth
						
Approximate Time Intervals (Yrs)	0-4	5-10	11-39	40-99	100-224	225+
Canopy closure	---	XX	XXXX	XXXXX	XXXX	XXX
Herbage production	XXXXX	XXX	XX	X	XX	XXX
Shrub production	X	XXXXX	XX	X	XX	XXX
Canopy volume	---	X	XX	XXX	XXXXX	XXXX
Plant diversity	XXXX	XXXXX	XXX	X	XX	XXXXX
Structural diversity	X	XXX	XX	X	XX	XXXXX
Animal diversity	XXX	XXXX	X	XX	XXXXX	XXXX

Secondary succession in a western hemlock climax forest begins with a relatively short grass-forb stage consisting of annual herbaceous species, followed by rapidly built-up populations of perennial herbaceous species. After approximately four or five years, shrubs become increasingly dominant and the shrub seedling sere begins. The composition of species is dependent on the presence of seed trees and the prevailing soil and moisture conditions. Invading tree species are typically fast-growing, shade-intolerant subclimax species. The pole-sapling stage occurs typically 11 years following the initial disturbance.

As the saplings grow, they form young forest stands of primarily homogeneous composition with little underbrush. These shade-intolerant trees are unable to reproduce themselves beneath their own dense canopy, and in the mature stage (approximately 100 years), the more shade-tolerant climax species become established and gradually became predominant within the forest stand. The climax species dominate old growth forest and there are several layers of vegetation creating great structural diversity. Old growth hemlock forests occur approximately 250 years following timber harvest. Western hemlock dominated forests reach climax conditions at approximately 400 years. (12, 24, 27, 39).

Seral communities at Mud Mountain Dam vary from grass-forb and shrub-seedling stages in those areas recently disturbed by floods, to mature forest stands. Only two very small patches of old growth exist, although remnant old growth trees are scattered throughout the project lands.

Photograph 3

Old-growth forests, unique wildlife habitats found in two very small patches and sparsely scattered throughout project lands.

The majority of the lands are fairly characteristic of young and mature forests. Community composition is highly affected by the moist and sandy soil conditions created by the White River. The rate of successional progression in riparian areas may vary substantially from the estimated time intervals shown in Figure 3. Riparian associated species including red alder, bigleaf maple and black cottonwood are prevalent and represent subclimax species in riparian forests. Douglas fir is the principal subclimax species on the slightly drier soils. These species are less shade-tolerant than the climax species, and once western hemlock or western red cedar become established, they will predominate. Sitka spruce, a riparian and coastal associated species, is categorized as only slightly less shade tolerant than the climax species. Its persistence in mature and old growth forest stands indicates it may function as a near climax tree species under appropriate conditions (39). Areas dominated by Sitka spruce on project lands may maintain their species composition through time, although once established, western hemlock or red cedar will slowly gain prominence.

I have added a column on the plant community descriptions, prepared for the Master Plan and reprinted in Table 4, which estimates the approximate seral stage of each plant community. The plant community descriptions in Table 3 and on the Vegetation Mosaic (Plate 2) are only broad representations of the area. Within each of the plant community categories, there exists many variations from the described characteristics. The successional stage estimations are therefore also generalized, and I recommend that prior to the intiation of any management actions, a close evaluation of the affected areas be conducted.

FOREST HABITAT

Habitat diversity is of prime importance in maintaining wildlife populations which are both diverse in composition and rich in numbers. The diversity of forest habitats and resultant wildlife diversity are directly proportional to the degree of horizontal and vertical stratification. Horizontal stratification (plant community diversity) at Mud Mountain Dam is fairly broad. Both coniferous and hardwood forests, as well as mixtures of the two, are present. Vertical stratification is indicated by the successional stage (plant structures) of the various communities. With the exception of old growth forests, which are notably lacking on project lands, Mud Mountain Dam has a balanced spectrum of successional forest seres.

Animal selection of habitat is based upon individual species requirements and the arrangement of food, water, and cover in space and time. It is possible, therefore, to predict with some degree of accuracy the structure of animal communities within forest ecosystems of distinct composition and structure.

Species orientation to successional stages has been determined for animals in the Blue Mountains of Oregon by Thomas and others (36). Animal response to structural characteristics is universal and consistent among a specie. Exhibit C indicates the orientation of species present at Mud Mountain Dam to successional stages. (Species absent from this list have unknown orientation.) This information is particularly useful for predicting responses to management actions which will have a significant effect upon the successional progress of the plant communities. Table 4 indicates the anticipated changes in structural appearance of forest communities due to various management practices.

The analysis of species preference for plant communities at Mud Mountain Dam was not within the scope of this project; however, distinctions between species utilization of coniferous and hardwood forests have been determined in previous research (4).

Table 4. Anticipated changes in structural appearance of forest communities due to management actions.

Management Action	Successional stage of condition					
	Grass-forb	Shrub-Seedling	Pole-Sapling	Young	Mature	Old
Regeneration cut:						
Clearcut				←	←	←
Shelterwood				→	←	←
Seed tree				←	←	←
Salvage			←	←	←	←
Thinning (including single-tree selection)		→	→	→	→	→
Brush control:						
Herbicides	→	→	→	←	←	←
Mechanical control	←	←		←	←	←
Controlled burn:						
Cold burn	←	←	→	←	←	←
Hot burn	←	←	←	←	←	←
Fertilization		→	→	→	→	
Planting:						
Trees	→	→		→	→	
Shrubs	→					
Grasses-forbs	→	←		→	→	

Advances succession → Retards succession ←

No effect on succession --

LOGS

Logs are significant components of forest ecosystems and are essential to the preservation of a natural community. They serve as wildlife habitat for a variety of birds, mammals, reptiles, and amphibians, by providing sites for feeding, protection, reproduction, and observation. Wildlife use of logs for feeding and reproduction at Mud Mountain Dam is indicated in Table 5. The persistence of logs (400-500 years) is of special importance in providing wildlife with habitat continuity over long periods of time and through major disturbances. Their presence in early successional stages, therefore, is as important as later stages. Logs additionally serve as substrate for the reproduction of tree species, especially western hemlock, and are functional components of nutrient cycling (13). Snags similarly are an integral feature of forest ecosystems and will be discussed in a later section.

Table 5. Wildlife use of logs for feeding and reproduction*(37)

Species	Utilization
MAMMALS	
Vagrant shrew	XO
Dusky shrew	XO
Northern water shrew	O
Townsend's mole	O
Coast mole	O
Snowshoe hare	O
Eastern cottontail	O
Townsend's chipmunk	O
Eastern gray squirrel	O
Chickaree	O
Beaver	O
Northern flying squirrel	O
Deer mouse	XO
Bushytail woodrat	XO
Boreal red-backed vole	XO
Heather vole	X
Longtail vole	X
Porcupine	X
Black bear	O
Marten	O
Shorttail weasel	XO
Longtail weasel	XO
Mink	XO
Spotted skunk	XO
Striped skunk	XO
Bobcat	O
Mountain Lion	O
Coyote	O
Red Fox	O
REPTILES AND AMPHIBIANS	
Common garter snake	O
Long-toed salamander	O
Western toad	O
Pacific treefrog	O

Species	Utilization
BIRDS	
Canada goose	X
Mallard	X
Wood duck	X
Barrow's goldeneye	X
Harlequin duck	X
Hooded merganser	X
Common merganser	X
Goshawk	O
Sharp-shinned hawk	O
Cooper's hawk	O
Blue grouse	XO
Ruffed grouse	XO
Bobwhite	XO
California quail	XO
Mountain quail	XO
Ring-necked pheasant	X
Common flicker	O
Pileated woodpecker	O
Lewis' woodpecker	O
Hairy woodpecker	O
Downy woodpecker	O
Willow flycatcher	O
Western flycatcher	O
Olive-sided flycatcher	O
Steller's jay	O
Black-capped chickadee	XO
Chestnut-backed chickadee	O
Bushtit	O
Red-breasted nuthatch	O
Brown creeper	O
Dipper	O
House wren	XO
Winter wren	XO
Swainson's thrush	XO
Townsend's solitaire	XO
Starling	X
Nashville warbler	O
Chipping sparrow	XO
White-crowned sparrow	O
Fox sparrow	O
Lincoln's sparrow	O
Song sparrow	O

X = used for reproduction purposes O = used for feeding

*Species may exist here which utilize logs, but do not appear on the list.

MANAGEMENT OF FOREST HABITAT

The management objective of the forest wildlife habitat at Mud Mountain Dam should be to preserve it in as undisturbed a condition as possible. It is inherently diverse due to the riparian influences and will most likely maintain this diversity if untouched. Surrounding lands are managed extensively for timber harvest; therefore, management of project lands as a natural ecosystem would benefit local wildlife.

The following points should be considered in forest management:

1) Existing old growth areas should be maintained. Old growth is an essential habitat and very little remains in timber harvest regions such as the Pacific Northwest. Old growth at Mud Mountain Dam represents only a very small percentage of total forest land and should be retained in its entirety.

2) Timber harvesting is not recommended in this area. In addition to the need for a natural area, timber on project lands is generally located in areas where harvesting would create severe erosion, detrimental to river and soil quality. If harvesting is deemed necessary, cutting should be done in small patches leaving as wide a buffer strip for streams and rivers as possible. Selecting small patches scattered throughout the project lands would create spatial diversity of successional patterns as the patches reforested. Guidelines for harvesting indicated in the section on Elk should be considered.

3) All snags and logs should be retained undisturbed.

WETLAND ECOSYSTEMS

Periodic river flooding, wet climatic conditions and the presence of upland springs draining into lowland areas have resulted in the formation of wetland areas on project lands. Diverse in composition and vegetation, as well as successional characteristics, they represent habitat for a wide variety of animal species. The Unique Habitat Map (Plate 1) designates the approximate locations of wetlands observed in this study.

Seasonal heavy rainfall and early spring meltwaters annually flood the White River bottomlands, covering portions of the lower valley terraces with water of varying depths, and creating SEASONALLY FLOODED FLATS. During this time, the topography of the terraces is shaped as silt and fines are deposited and shifted. Upon recession of the floodwaters, depressions are left filled with water, creating PONDS. These then become collection points for upland springs and spring-fed streams. Although location may change yearly, the presence of ponds within the area is consistent.

WET MEADOWS, with waterlogged soils are created by upland springs, heavy rainfall and spring-fed streams, and may be found in the willow/alder and cottonwood/alder plant communities.

Due to the extremely moist climate conditions and presence of numerous springs on the project lands, BRUSH SWAMPS and WOODED SWAMPS may be found scattered throughout the project lands. Water in these areas varies seasonally, but may reach levels of 6-12". Brush swamps have been located in the cottonwood/alder and willow/alder plant communities. Wooded swamps

have been found in the mixed hardwood forest adjacent to the large marsh and in the Sitka spruce/hemlock forest ecosystem. Other swamps adjacent to sluggish streams or near springs are undoubtedly present.

Photograph 4

A large marsh with two distinct vegetation zones contains a forested island visible in the picture.

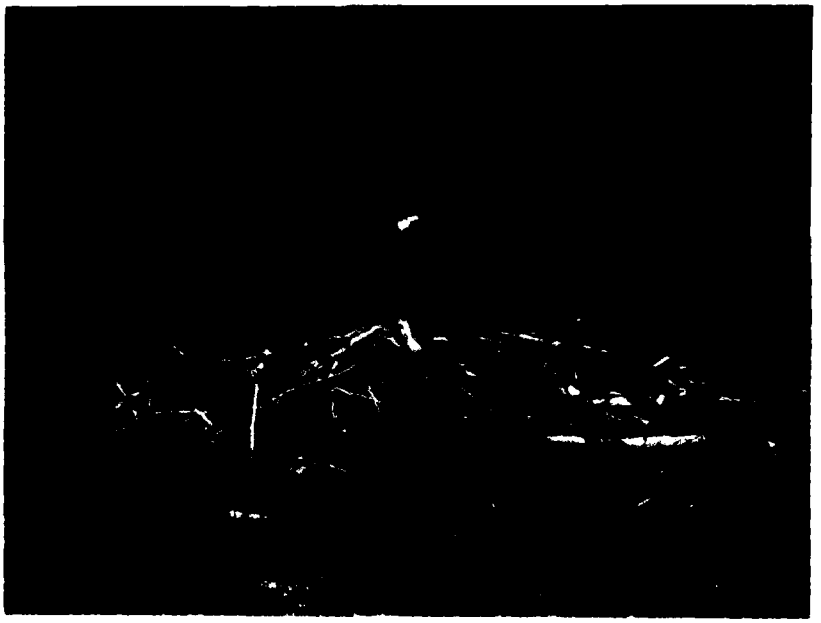
Two primary MARSH areas are found on project lands. The larger of the two marshes is fairly deep (greater than 10 feet in places), with two distinct vegetational zones: one characteristic of a deep-water marsh, and the other with deep water, but more reminescent of bog areas. Plant species identified within the marsh may be found in Table 6. (This represents only a few of the prominent species; other marsh plants are present.)

Table 6. Plant species observed in the large marsh. *

Duckweeds	Lemna sp.
Pondweeds	Potamogeton sp.
Sphagnum moss	Shagnacae
Sedges	Carex sp.
Bulrush	Scirpus sp.
Cattails	Typha latifolia
Deer fern	Struthiopteris spicant
Sun-dew	Drosera rotundifolia
Cranberry	Vaccinium oxycoccus
Pearly everlasting	Anaphalis margaritacae
Salal	Gautheria shallon
Trailing blackberry	Rubus sp.
Labrador tea	Ledum groenlandicum
Swamp laurel	Kalmia polifolia
Douglas spirea	Spirea douglassii
Osoberry	Osomaronia cerasiformis
Wild crabapple	Malus sp.
Western redcedar	Thuja plicata
Western hemlock	Tsuga heterophylla

*This is not an inventory, only a list of species observed.

Situated on an outer edge of the marsh is an island, forested primarily with hemlock, cedar, and fir, in a relatively young forest stand. In dry months, a land bridge connects the island with the surrounding forest areas, but much of the year water completely surrounds the small island. This island represents a unique opportunity for species requiring both forest and marsh habitat areas.



Photograph 5

Marshes and other wetlands are critical to wildlife providing habitat for many species. This beaver lodge was constructed in the large marsh.

A smaller marsh is present on the southern half of project lands. Ownership of this marsh is divided between the Army Corps of Engineers and the University of Washington.

IMPORTANCE TO WILDLIFE

Wetland areas contribute significantly to the diversity and number of wildlife species inhabiting project lands. Primary emphasis in appraising wetland value in the past has been placed upon waterfowl. However, Exhibit D indicates wildlife use of riparian and wetland ecosystems and from this, it can be seen that many species of wildlife are dependent upon wetlands as critical habitat.

MANAGEMENT OF WETLANDS

Existing wetland areas are important to the natural perpetuation of the wildlife community and should be protected from disruption.

Population levels of many species, especially waterfowl, are limited by territorial requirements for wetland areas. The practice of artificially creating ponds has successfully occurred in many areas and has increased the population potential for many wildlife species, especially waterfowl. It has been noted by project personnel that some of the ponds located on the lower valley terrace shift location after yearly flooding, while others have appeared in the same approximate location for consecutive years. Conceivably, artificial ponds could be created which would remain relatively stationary through time. With appropriate planning, no adverse ecological disruption to the surrounding habitat need occur. Additional research on the feasibility of this is recommended.

Ownership of the small marsh on the south river shore is currently divided between the Corps of Engineers and the University of Washington. I recommend that jurisdiction of the ecosystem be placed under one governing unit so that management is consistent and conflicts of interest do not arise.

A comprehensive wetland inventory of project lands should be conducted to provide additional managment guidelines.

INTERPRETIVE POTENTIAL

The wetland areas at Mud Mountain Dam attract a wide variety of wildlife species, creating some valuable interpretive possibilities. Interest from the local college concerning use of the area (particularly the marsh) in educational studies has been expressed.

A spur trail is currently planned which will lead from the rim trail to the marsh area where observation of wildlife will be possible. The construction of simple bird blinds here would increase wildlife appreciation. In addition, species lists of wildlife could be easily compiled and made available to visitors.

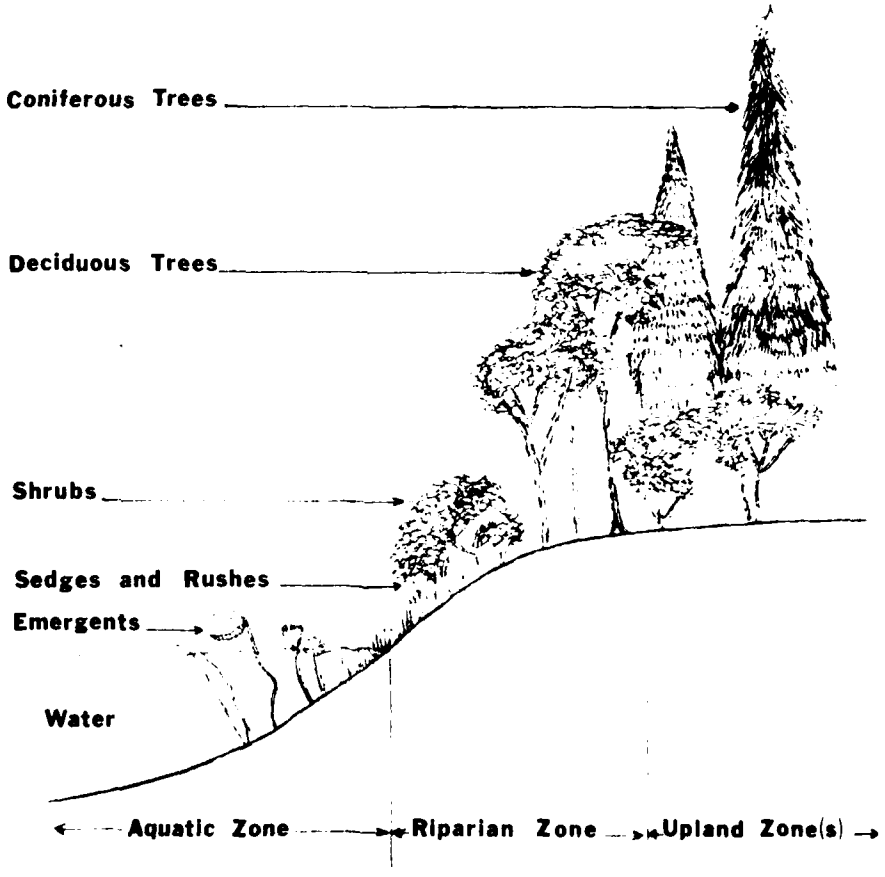
A considerable portion of the large marsh consists of floating vegetative mats of sphagnum moss and other plants which may be cautiously walked upon for better observation of the marsh and floral species. This could be a safety hazard, however, and excessive travel on the mats would damage many of the species. The addition of an unobtrusive floating dock may alleviate these problems and provide a better vantage point of the marsh. Placement of the dock should be out of view of any bird blinds to prevent disruption of birdwatching activities. The northwest corner of the island provides access to the sphagnum moss areas although placement of the dock here would entail additional construction of a small bridge to the island.

RIPARIAN ECOSYSTEMS:

Streamside or riverside communities, known as "riparian habitat" are an aggregation of floral species which depend on a flow of water on or near the surface for subsistence.

Riparian zones are characterized by different stages or levels of vegetation progressing from the water. Figure 4 depicts these levels.

Figure 4. Characteristic vegetative stages of Riparian Zones.



Portions of the riparian areas at Mud Mountain Dam have been extensively disrupted by dam activities and represent a serious loss to wildlife within project boundaries. Over half of the White River and approximately half of Scatter Creek, as well as the entire length of Cascade Creek, have been extensively disrupted by dam activities. The remainder of riparian areas are undisturbed and have healthy plant communities. These have been identified on the Unique Habitat Map, Plate 1.

IMPORTANCE TO WILDLIFE

Riparian habitats often contain all three critical habitat components (food, water, cover) and are therefore extremely important to wildlife. Exhibit D indicates animal species which utilize, and in some cases are highly dependent upon, riparian habitat. The undisturbed riparian habitat represents the smallest percentage of the habitat types on project lands and yet is the most widely used by wildlife. These areas are critical wildlife habitat and the previous loss of a large portion of riparian areas through habitat disruption is extremely detrimental to the wildlife. Every attempt should be made to maintain the undisturbed river and stream communities in their present condition.

SNAGS

During the spring and summer of 1974, the level of the White River behind Mud Mountain Dam was raised, and a pool was maintained in order to determine seepage through the dam construction material. During this time, the water level rose as high as 1150' msl and was maintained at 1130' msl for a period of two months. This resulted in the creation of approximately 458 acres of dead trees (snags).

Many resource managers have considered the presence of snags as detrimental due to their contributions to safety and fire hazards. Therefore, fire control and safety organizations have recommended that snags be removed wherever possible. However, recent studies have indicated that snags have significant value to wildlife and that certain species are dependent upon their presence for survival. Because of this, it would be beneficial to consider retaining some, if not all, of the snags on Mud Mountain Dam project lands.

Photograph 6.

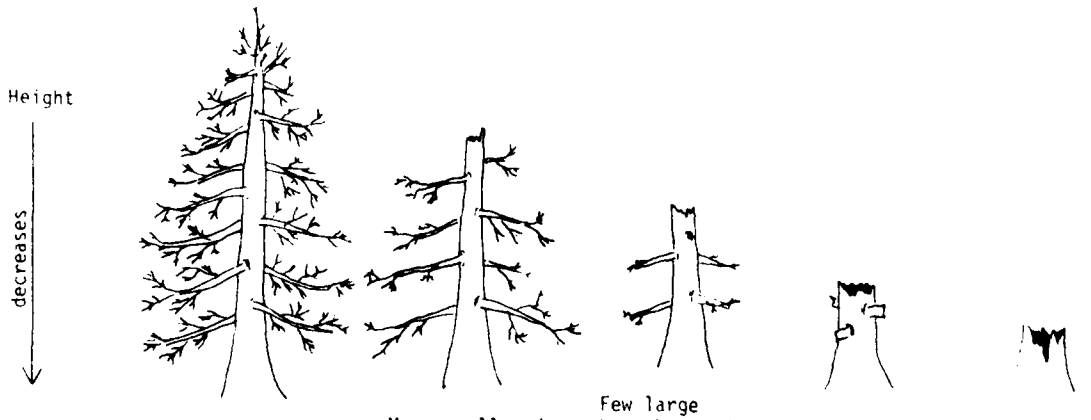
Snag patches, created by high water levels, are prevalent on project lands. Successional progress is inhibited in many of these areas by yearly flooding.

SNAG ECOLOGY

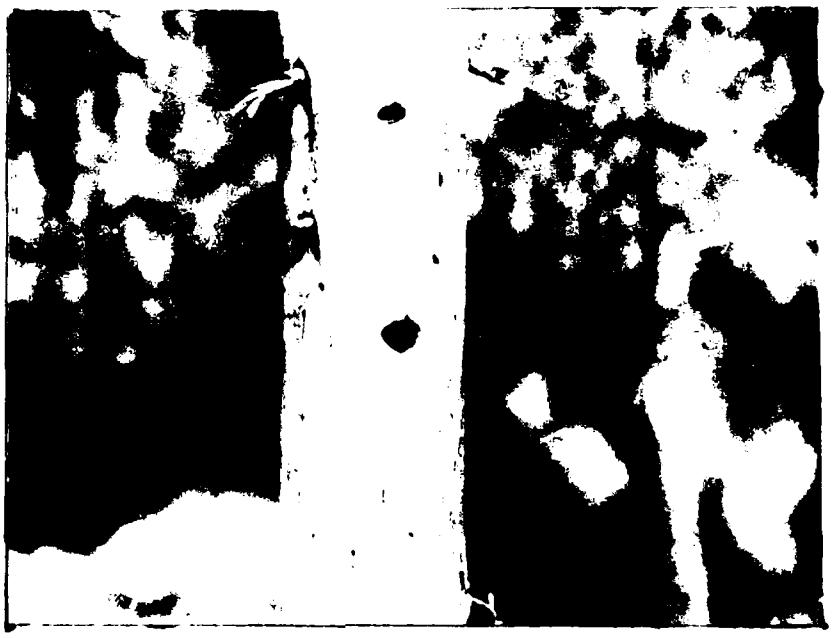
Despite the importance of snags to wildlife, little of basic snag ecology for tree species within the western hemlock vegetation zone is known. Studied have been conducted in western larch and Douglas fir-dominated forests, and from these studies, some information can be extrapolated (7, 9, 20, 21, 34).

Of primary importance in understanding snag ecology is considering snags not as dead trees, but as dynamic entities which provide wildlife habitat. Snags, like living trees, undergo successional progression as their physical characteristics change with age and decay. The distinction between decay stages in snags is indicated by the number and size of branches, degree of wood decay, amount of remaining bark, and in some instances, the condition of the top and height of the snag. Douglas fir is the only species of tree present at Mud Mountain Dam whose decay characteristics have been studied and these are portrayed in Figure 5. It should be appreciated that patterns of decay and snag longevity vary significantly between tree species. Other variable parameters affecting decay rate include tree size and condition, cause of death, and environmental exposure. Snags with broken tops or surface wounds have exposed heartwood, creating sites of rapid fungal invasion which increases the rate of heartwood decay, a critical factor for wildlife. Broken tops are characteristic of some species, but only environmental accidents for others. The ultimate "climax" of snag decay is the final collapse of the snag. A great number of snags fall early in their decay succession, especially small snags.

Figure 5. Snag succession characteristics of Douglas fir snags (9).

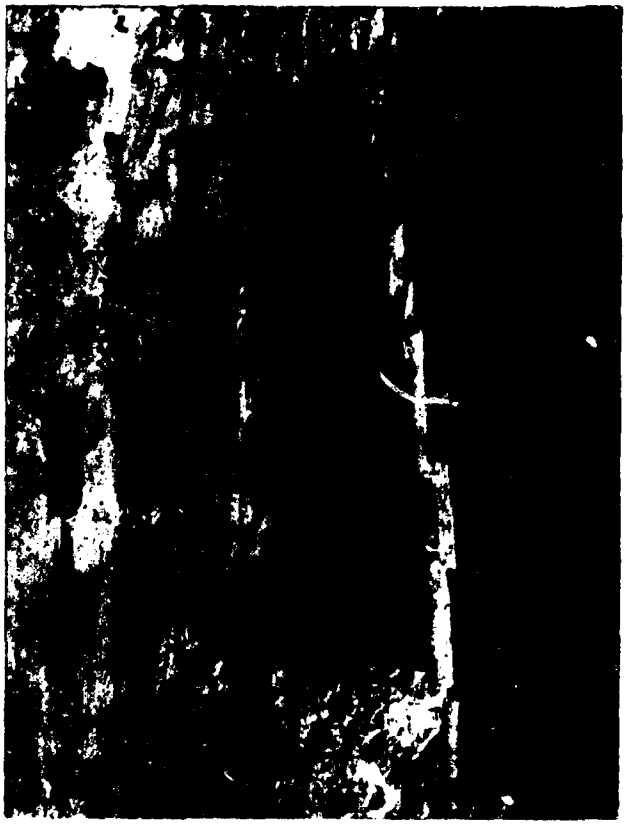


Branch condition	All branches	Many small and large branches	Few large branches and stubs	Stubs	None
Wood decay at base	Sapwood and heartwood sound	Partial sapwood decay, heartwood sound	All sapwood decay, partial heartwood decay	Both sapwood and heartwood decay	Sapwood falling or gone, heartwood decay
Percent bark cover		generally decreases			
Estimates of snag longevity (years since death of tree)					
10-18 cm dbh	4	8	16	35+	--
20-46 cm dbh	5	13	29	69	90+
48 cm+	6	18	50	125	250+



Photograph 7

Wildlife use of snags will increase as the snags age. Nesting cavities have been excavated in suitable snags within the snag patches.



Photograph 8

Older, more decayed snags, found within the forest, show evidence of pileated woodpecker excavations.

IMPORTANCE TO WILDLIFE

Snags are prime habitat for cavity nesters and provide feeding substrate for a number of birds and mammals. A few species of birds are capable of excavating holes into the snag wood (cavity excavators). These holes are then utilized by numerous other species of birds as nesting and roosting cavities. In addition, wildlife use of snags includes perching and drumming.

The extent of wildlife use is dependent on the degree of sapwood and heartwood decay, height and diameter of snags, and the surrounding habitat type. Individual preferences vary between species, but some generalities can be made. Some degree of heartwood decay is essential for cavity excavation. However, sound sapwood is necessary to retain hole shape. Snags with rotted sapwoods may be used for one nesting season, but generally deteriorate beyond suitability by the following season. Cavities in trees with a sound sapwood "shell" may be used for successive breeding seasons. In general, snags less than 6-inch diameter breast height (dbh) are not used extensively and stubs shorter than 25 feet are not selected. (21, 34)

Surrounding habitat is another determinant of snag wildlife value. Old growth, riparian and wetland habitats support a high density and diversity of hole nesters. Cottonwood snag groves rate especially high in wildlife use. Snags in patches are beneficial, as they provide some protection from avian predators. (21)

SNAGS AT MUD MOUNTAIN DAM

In 1974, approximately 458 acres of snags were created. These are concentrated in several snag patches of varying sizes and isolated snags scattered throughout the project lands along the lower edge of the undisturbed forest ecosystems. The Unique Habitat Map illustrates the approximate locations of these snags.

The snags are currently in their fourth year of decay, having been created in 1974. Presently, they have only marginal potential for cavity nesters. Cavity excavations exist in a number of snags and the presence of hole nesters on project lands has been noted. However, their wildlife potential will increase with age and both the density and diversity of animal species can be expected to increase. Table 7 identifies general species which either excavate, nest, or use snags as feeding stations. Species of tree snags present on project lands are found in Table 8.

Table 7. Bird and Mammal Species utilizing snags for feeding sites and reproduction (7, 37)

BIRDS

Cavity Excavators

Red-breasted nuthatch
Hairy woodpecker
Downy woodpecker
Pileated woodpecker
Yellow-bellied sapsucker
Common flicker
Lewis' woodpecker

Exclusively Cavity Nesters

Wood duck
Common goldeneye
Barrow's goldeneye
Bufflehead
Harlequin duck
Hooded merganser
Common merganser
Spotted owl
Sawhet owl
Screech owl
Pygmy owl
Sparrow hawk
Tree swallow
Black-capped chickadee
Chestnut-backed chickadee
Purple martin
Vaux's swift

Sometimes Cavity Nesters

Barn owl
Starling
House sparrow

Violet-green swallow
House wren
Winter wren
Bewicks' wren
House finch
Brown creeper (nests behind bark)

Use Snags for Feeding Sites

Goshawk
Sharp-shinned hawk
Cooper's hawk
Western kingbird
Hammond's flycatcher
Red-tailed hawk
Bald eagle
Osprey
Great horned owl
Flicker
Pileated woodpecker
Lewis' woodpecker
Hairy woodpecker
Downy woodpecker
Nuthatch
American kestrel
Screech owl
Pygmy owl
Black-capped chickadee
Brown creeper
House wren
Belted kingfisher

ANIMALS

Cavity Nesters

Chickaree
Yuma myotis
Long-eared myotis
Long-legged myotis
California myotis
Silver-haired bat
Big brown bat

Northern flying squirrel
Raccoon
Marten
Deer mouse

Use Snags for Feeding Sites

Chickaree
Northern flying squirrel
Marten
Deer mouse

Table 8. Snag species present at Mud Mountain Dam

Red Alder	6-12" dbh
Bigleaf Maple	6-20" dbh
Black Cottonwood	6-20" dbh
Western Hemlock	5-20" dbh
Douglas Fir	6-20" dbh

MANAGEMENT OF SNAGS

The presence of 458 acres of snags on Mud Mountain Dam project lands offers the Corps a unique opportunity to initiate management of cavity nesters and other species of animals which utilize snags. Carefully managed, that which has been termed "the loss of 458 acres of timberland" and has been viewed as detrimental to the aesthetics of the project lands could become a benefit to the wildlife, with significant opportunities for interpretive participation in the management program. For these reasons, I highly recommend the development of a comprehensive snag management plan. Several points of importance should be considered in the development of such a plan.

1) I recommend that the majority of the snags be left undisturbed. The presence of snags is not detrimental to project operations and is highly beneficial to wildlife. The majority of the snags are located on inaccessible areas of the project lands and do not constitute a safety problem. Snag areas used for interpretation could be appropriately marked to warn visitors of the instability of standing snags. Mud Mountain Dam is subject to moist climate conditions and the occurrence of lightning is low. Snag fire hazard should not be considered a problem, but, in the event of very dry weather, the area would have to be closely watched.

2) If it is deemed necessary to eradicate some of the snags, the habitat requirements of cavity nesters and other snag users should be examined to insure that retained snags provide optimum benefit to wildlife species. If the habitat requirements for cavity excavators are met, then it can be safely assumed that the requirements for nesting and shelter of cavity nesters will be provided. Thomas et al (34) have derived a management plan for maintaining selected population levels of woodpeckers by manipulating the size and characteristics of snags and insuring that appropriate types and accurate numbers are allowed to stand. The following assumptions have been used in developing this management plan:

a) Woodpecker numbers are limited by the number of snags available for nesting,

b) Each woodpecker pair requires one to three sound snags (one nest, two roosts) each year, and

c) For every suitable snag, there are 15 that are not.

The computation of necessary snag numbers is based on the following formula:

$$\text{Number of snags per 100 acres} = \frac{\text{Number of cavities excavated} \times \text{15 unused snags} \times \text{100 acres}}{\text{Territory size}}$$

Table 9 lists the species requirements for territory size and the number of cavities excavated per year for woodpeckers found in the Pacific Northwest (38). Using this formula, it is possible to compute the number of snags required per 100 acres to support different percentages of maximum populations of woodpecker species.

Table 9. Territory size and number of cavities usually excavated by woodpeckers in the Pacific Northwest (38)

Species	Territory Size in Acres	Number Cavities Excavated/Year
Pileated woodpecker	300	3
Common flicker	40	1
Lewis' woodpecker	15	1
Yellow-bellied sapsucker	10	1
Hairy woodpecker	25	1
Downy woodpecker	10	2

In addition to territorial requirements of cavity excavators, physical parameters of the snags should be considered. Each species of woodpecker has different requirements for size of snags suitable for cavity excavation. These preferences are listed in Table 10 which indicates snag numbers and size requirements for the maintenance of woodpecker population levels in the Pacific Northwest at 100, 70, and 40 percent of maximum population numbers (38).

Table 10. Snag numbers needed to maintain woodpeckers at designated levels at Mud Mountain Dam (38)

Minimum Snag Size in Inches	Species	Snags Required Per 100 Acres to Support Percentage of Population Maximum		
		100%	70%	40%
≥6	Downy woodpecker	300	210	120
≥10	Yellow-bellied sapsucker	150	105	60
≥10	Hairy woodpecker	180	126	72
≥12	Common flicker	38	26	11
≥12	Lewis' woodpecker	100	70	40
≥50	Pileated woodpecker	15	11	6

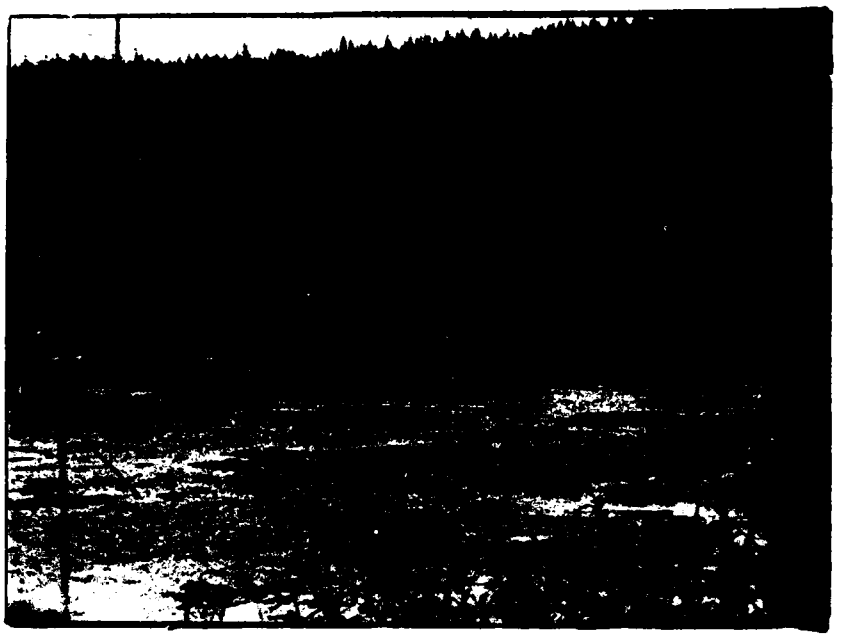
In using this information, it is important to remember that a larger snag can serve in place of a smaller one, but the reverse is not true. As an example, consider that it is decided to maintain all six species of woodpeckers at 100 percent population levels. That would mean that 15 snags per 100 acres ($\geq$ than 20" dbh) would be preserved for the pileated woodpecker. Because these snags are larger than the minimum 12" dbh snags required by the common flicker, they are able to be substituted; i.e., when the pileated woodpecker was provided for, 15 of the 38 snags required by the common flicker were provided as well. Therefore, if 15 snags $\geq$ 20" and 23 snags (38-15) $\geq$12" are provided, then 38 (15+23) of the 100 snags required by the Lewis' woodpecker are also provided. Following this line of reasoning through the chart from largest dbh to smallest dbh requirements, the end result is that a minimum of 683 snags are required per 100 acres for 100 percent population levels of all six species. These snags would be divided into the following size classes: 15$\geq$20" dbh, 85 $\geq$12" dbh, 80$\geq$10" dbh and 120 $\geq$6" dbh. These would supply the necessary nesting and roosting sites for all six woodpeckers, as well as the cavity nesters which cannot excavate their own holes (7).

In the selection of appropriate snags the decay state of snags should also be considered. Snags in early decay states should be chosen but any snags with existing cavities should be retained.

Snags serve as a forage substrate for many birds and a number of mammals. In general, these species will forage on snags of any age and generally most sizes. The essential factor is the occurrence of insect infestation which will occur on most dead trees, with the exception of very small snags. Many of the very small diameter snags (6" dbh) could be removed with no detrimental effect upon the foraging or nesting wildlife. However, unless necessity dictates some snag removal, they could be left as perches for small birds.

3) Snags located in optimum habitat should be retained. Riparian and wetland ecosystems are critical and snags within 300' of water should not be removed (13).

Within the forested ecosystem, there are many naturally occurring snags. An inventory of these snags for size, species composition, and approximate number per acre would be helpful in a snag management plan. Many cavity excavators require mature to old growth forest for reproduction and the retention of snags in these areas is advisable.



Photograph 9

Snags close to water areas are especially critical to wildlife. This pond, located on the lower valley terrace has retained its position during consecutive years of flooding.

4) The ultimate climax of snag decay is the total deterioration of the snag. This natural demise will result in loss of habitat to snag dependent species. Under natural conditions, new snags would be formed as a part of the tree life cycle. The creation of snags at Mud Mountain Dam was a unique occurrence and not likely to be duplicated in the future. Naturally occurring snag replacements will not begin to meet snag requirements for the populations of cavity nesters which will be attracted tc the snags on project lands. As part of the snag management plan, gradual snag replacement should be coordinated to meet requirements for reasonable population levels of cavity users.

INTERPRETIVE POTENTIAL

Snags and associated wildlife management at Mud Mountain Dam provide an excellent opportunity for interpretation. As snags are a rather unique habitat, the interpretive possibilities are also unique. The planned Rim Trail will circumnavigate the entire project land area. Access to simply constructed bird blinds close to snag areas would provide a rare opportunity for the public to observe these species and for the Corps of Engineers to interpret snag ecology and management to the public. Bird and mammal species lists could be prepared and would enhance the public's awareness of observable species. Favorable locations for bird blinds should be explored as population levels increase. Selecting snag patches around water would probably provide observation of diverse species of snag users.

ELK

HISTORY

Rocky mountain elk, although not an indigenous species of Washington, a[re] today commonly found within the state. Several introductory plants occurred between 1912-1915, and from these plantings fairly large populations [h]ave arisen. The elk utilizing the Mud Mountain dam project lands are de[s]cendents of an elk herd introduced in 1913 on Grass Mountain. Forty elk were captured in Yellowstone National Park and brought to Enumclaw on December 31, 1912. These were kept within a corral near the White River Lumber Company mill until March 26, 1913, at which time, 36 elk were released on Grass Mountain. The average age was between 1-1/2 to 2-1/2 years and the bull to cow ratio was 1:3. (8)

ELK ECOLOGY

A summary of elk ecology is provided here to indicate preferred habitat areas and elucidate upon habitat requirements as guidelines for management decisions.

Elk are primarily migratory animals, moving with the changing seasons. The winter ranges are located along river bottoms and on lower south-facing mountain slopes where elk find suitable food and protection from harsh winter weather. In the spring, elk move to higher elevations as food becomes available and spend the summer months feeding in upper elevation clearcuts and other open areas. During the late summer and fall breeding season, the elk are highly mobile, moving to lower elevations as winter approaches. However, some elk herds are less mobile in nature and remain within lower elevation habitats as year-round residents.

Feeding habits and preferences of elk vary, depending upon season, composition of plant communities and food availability. Table 11 depicts seasonal habitat characteristics and food type preferences determined for elk in the

Cedar River drainage (approximately 15 miles north of the White River). In general, the principal food types are sedges, grasses, shrubs, forbs, ferns and conifers. Elk habitat is closely associated with water, and riparian and wetland areas are used during all seasons, but particularly winter, spring and fall. Within forest ecosystems, mixed and deciduous stands are favored. The successional stage of the forest greatly affects the quantity and quality of available forage. Dense, young forests have sparse understory which is generally of low nutrient quality. Open stands, such as mature forests, very decadent climax forests, and the edges of marshes and streams, produce forage of quantity and quality capable of sustaining elk populations.

Table 11. Seasonal habitat and food type preferences for elk observed in the Cedar River watershed (32)

	WINTER	SPRING	SUMMER	FALL
Principal Food Types (In order preferred)	Sedges Ferns Shrubs Hemlock	Sedges Ferns Shrubs Hemlock	Forbs Shrubs Grasses Sedges	Shrubs Grasses Cedar Sedges Ferns
Preferred Forest Habitat Characteristics	Deciduous or mixed forests with open to medium canopy	Deciduous or mixed forests with sparse canopy	Clearcut or second-growth forests with open to medium canopy	Hemlock/hardwood forests mixed forests with sparse to medium canopy
Habitat Associations	Very near riparian and wetland areas	Very near riparian and wetland areas	Near riparian and wetland areas Brushy habitat	Very near riparian and wetland and meadow areas. Brushy habitat.

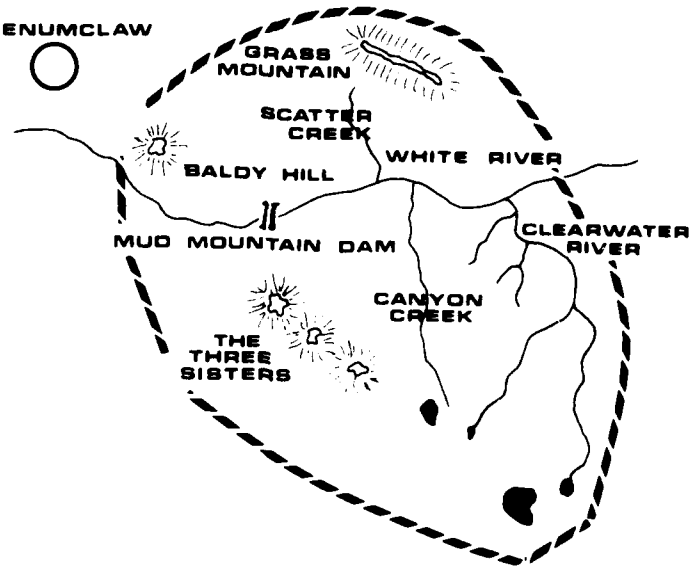
Clearcut logging has been determined to encourage vigorous growth of understory plants, especially shrubs, which increase forage for big game use. During summer months, clearcut areas are used extensively by elk. However, the majority of clearcut patches are too large to be used efficiently by wildlife. Opinions on optimum clearcut size for elk vary, although elk have been noted to remain no further than 50 yards from cover (29). The Washington State Department of Game judges optimum clearcut size to be 20 acres (26), and others have set the maximum size for efficient utilization at 50 acres (6). Narrow strips provide more edge and consequently more forage, as well as closer access to cover. The spatial arrangement of cover and forage also contributes to efficient land use by wildlife. A ratio of 40 percent cover to 60 percent forage provides optimum elk use of an area (34).

THREE SISTERS - GRASS MOUNTAIN ELK

Information concerning the ecology of local elk populations is presently being compiled from a variety of sources, and by 1980, detailed information should be available. The U. S. Forest Service, in conjunction with the Washington State Department of Game, is currently involved in an extensive study of the elk located in the White River area. The results of their study will be compiled into a Biological Unit Management Plan (BUMP) for elk, to be completed in 1980. This document will provide information concerning numbers, ranges, harvest, habitat, and limiting factors of the White River elk herds which will then be used to determine management objectives and practices. A University of Washington doctoral candidate, William Bradley, through the National Park Service, is conducting studies on elk within Mount Rainier National Park. The final product of his study should be published in October of 1978. Though no currently published information on local elk populations was available for use in this report, the preliminary findings of these studies have provided some valuable insights into population numbers and movements.

Elk have been collared by both groups of researchers for the purpose of determining migrational movements. The National Park Service began placing identifying collars on their elk in 1969, while the Forest Service initiated collaring activities in 1976 in the Greenwater area (east of Mud Mountain Dam). Of particular interest is the fact that, to date, no collared elk have been observed in the area north of Three Sisters, south of Grass Mountain, and west of the Clearwater drainage (which includes Mud Mountain Dam project lands). This indicates that elk inhabiting that region are a separate population from either the Mount Rainier Park elk or the Greenwater elk. Currently, the Department of Game (26) estimates the boundaries of the Three-Sisters-Grass Mountain herd to include those areas shown within the broken line in Figure 6. It should be noted that, while this information is not consistent with that found in the 1976 Mud Mountain Dam Master Plan, it is based on the most recent population studies of the area. Additional information, acquired by 1980, could provide further insights on elk movements.

The Forest Service estimates a population of approximately 800 elk occupy the 132,000 acres of the White River district. Cow-to-bull ratio has been observed to be 30-40 bulls per 100 cows (8). During the fall rutting season of 1978, a census flight of the Three Sisters-Grass Mountain area was conducted by the Army Corps of Engineers for the purpose of obtaining a reasonable estimate of the elk population. Based on numbers observed and an approximation of those not visible from the air, a population estimate of 150 elk was obtained. The Department of Game conservatively estimates a population of 100 elk within the Three Sisters-Grass Mountain area (26). Most likely, the population presently consists of 120-130 elk.



The Three Sisters-Grass Mountain elk herds are primarily migratory in their habits. A small resident elk herd may exist within winter range areas, but this has not been substantiated and should be explored further. Extensive clearcuts in surrounding timber lands serve as spring and summer range for the elk population. The primary winter ranges are located along the Clearwater and White River bottomlands and south-facing mountain slopes at low elevations. Food availability on winter ranges is the critical limiting factor for elk populations. Carrying capacity of the elk habitat has not been determined, but it is thought by the Forest Service (8) that a severe winter might reduce elk numbers as a result of food scarcity.

Mud Mountain Dam project lands serve as essential wintering range for a portion of the Three Sisters-Grass Mountain elk population. Exact numbers are not known and could only be determined during winter months. Elk sign is prevalent throughout the area, although high usage of particular areas is evident. The riparian, marsh, and intermittent pond habitats (refer to Plate 1) are important to the elk winter range and are utilized to some degree in summer. Feeding and bedding occur in open areas in the warmer summer months, but less in the winter when thermal cover is required. Periodic river flooding has inhibited plant succession in many areas and created natural openings throughout the project. In general, those areas designated on the Unique Habitat Map as snag patches presently function

as natural openings. Man-made openings such as maintained but little used access roads and open fields with a minimum of human disturbance function in the same manner.

Deciduous and mixed forest ecosystems are preferred winter forest habitat especially when thermal cover is needed and snow blankets food in open areas. The cottonwood/alder and willow/alder plant communities are used to some degree, although the hardwood/hemlock and mixed forest ecosystems constitute the primary plant communities utilized (Plate 2). Edges of habitats are generally high in plant diversity and contain considerable elk forage material. Areas where distinct ecotones exist are probably utilized for elk feeding. The remaining forested areas are used to a lesser extent, primarily for travel and thermal and hiding cover. Table 12 provides a list of plant species, found at Mud Mountain Dam, which are used as elk forage. Winter forage species are noted.

Table 12. Plant species commonly used as elk forage (23, 29, 30, 31, 32)

TREES	SHRUBS	FORBS	FERNS
*Western hemlock	*Willow	*Oregon grape	*Sword fern
*Western redcedar	*Salmonberry	*Salal	*Deer fern
*Douglas fir	*Huckleberry	Spring beauty	*Bracken fern
*Sitka spruce	*Trailing blackberry	Woodsorrel	Lady fern
*Alder	*Devil's club	SEDGES	MISCELLANEOUS
*Vine maple	Huckleberry		
Bigleaf maple	Mt. ash	*Carex sp.	Mosses
Black Cottonwood	Elderberry		*Lichens
	Currant		*Rotten wood
	Sorea		
	Serviceberry		
	Ocean spray		
	Rose		
	Bearberry		

*Primary species taken during winter.

MANAGEMENT OF ELK

In view of elk use of project lands as winter range, management for elk would best be accomplished by maintaining those aspects of the land essential for critical winter habitat. The following suggestions for management of critical areas and further research are recommended:

a. Timber harvest is not recommended. Mud Mountain Dam exists as a relatively undisturbed habitat area within an intensive timber harvest region. As a winter range, forested areas are essential for feeding and protective cover. If harvesting is deemed necessary for other resource management purposes, the size and shape of the harvest area should follow the guidelines for efficient elk utilization mentioned under Elk Ecology. Those plant community types preferred by elk should be retained if possible.

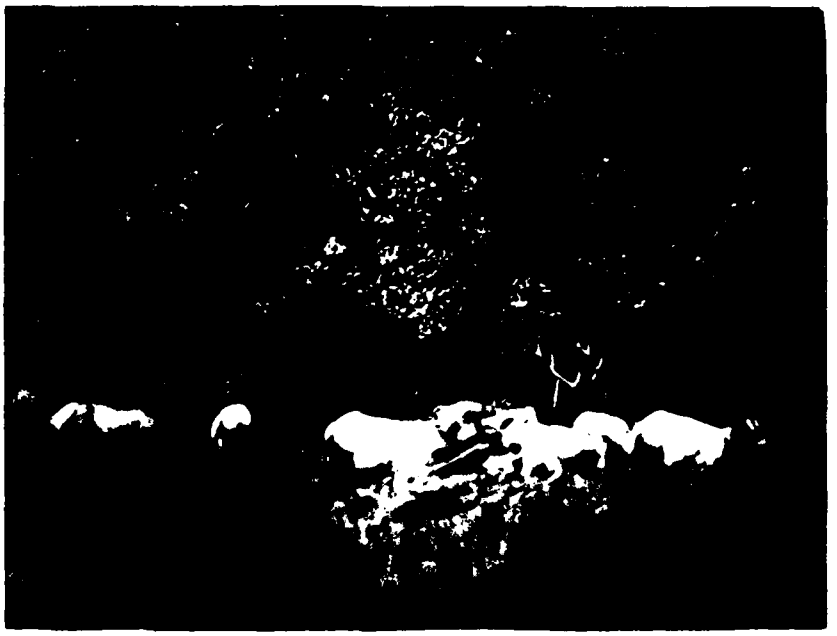
b. Riparian and wetland areas should be disturbed as little as possible.

c. Improved roadway access on the southern side of project lands is not recommended. Studies indicate that neither light foot travel nor limited automobile traffic substantially disturb elk, but a relatively undisturbed area in wintering range would be beneficial (28).

d. Population estimates of elk utilizing Mud Mountain Dam winter range should be made.

e. Coordination with the Forest Service and the Department of Game is highly recommended. Upon completion of the BUMP files, the Forest Service management plan will be determined. I recommend that prior contact with both agencies be made so that lands used by the Three Sisters-Grass Mountain elk population can be managed as one entity. References cited indicate individuals involved in game management within these agencies.

f. Additional information on elk ecology within the region will be revealed upon publication of William Bradley's doctoral dissertation and the BUMP files. Review of these publications would be beneficial.



Photograph 10

Elk utilize Mud Mountain Dam lands primarily as critical winter habitat. These elk were observed in their summer habitat at Howard Hanson Dam, north of Mud Mountain Dam.

PREDICTION OF WILDLIFE RESPONSE TO MANAGEMENT ACTIONS

The intention of this report is to provide a wildlife inventory and analysis of habitat at Mud Mountain Dam. Additionally, it has been hoped that enough information could be gathered concerning wildlife habitat requirements that the report could be used as a reference for predicting wildlife response to management actions. Several tables have been presented in the text of this report which should be useful in accomplishing this goal. The following example indicates the manner of use of this information:

> It has been decided that 400 acres of timbered forest will be harvested on project lands. Selected areas contain primarily mature forest stands and some scattered old growth and would entail the removal of 75 acres of snags, and eliminate a wooded swamp area.

The report can then be used in the following way:

Table 4 indicates that timber harvesting has a regressive effect upon forest successional stages. Therefore, the mature and old growth timber would revert to grass-forb and shrub seedling successional stages if harvested. This management action would be detrimental to those species listed in Exhibit C, as utilizing mature and old growth forests, and favor those preferring grass-forb and shrub seedling stages. (NOTE: Not all species present at Mud Mountain Dam have been studied to determine their orientation to successional stages, but this list does represent the majority of species in the area.) Table 7 lists species which are dependent on snags and would therefore be affected by the removal of 75 acres of snags. Exhibit D provides information on species which utilize wetland areas and could be affected by the removal of the wooded swamp area. (This exhibit is fairly generalized and not all species listed would use a wooded swamp--some would prefer an open pond or marsh.)

Through the use of these tables, a list of species which inhabit the specific habitat to be disturbed can be obtained. The relative degree of effect upon these species may now be evaluated by using Exhibit A and Exhibit B. The relative abundance of the species can be determined by using Exhibit A (indicating if species are rare or common to the area). Exhibit B categorizes species by life forms and will indicate whether these species use the affected areas for feeding, reproduction, both, or neither. Additional aspects could be considered, such as: what is the percentage of the affected area compared to total area (i.e., is the mature forest to be removed 90 percent of the total mature forest habitat or 10 percent)? Also, will this action significantly disrupt critical elk winter range?

By using the tables provided and considering all aspects of the management action, it is possible to determine the extent of disruption to wildlife and predict their responses. Expansion of the information already provided to include wildlife relationships to specific wetland habitats, number of elk on the winter range, life form categorization of all species found at Mud Mountain Dam, and the completion of species orientation to successional stages would increase the accuracy of the prediction. Existing information, however, can predict a general wildlife response to management actions, as indicated in the above example.

CONCLUSIONS

Although a percentage of the wildlife habitat on Mud Mountain Dam project lands has been severely disturbed by dam operations, an extensive area remains unharmed and supports a large number of diverse animal species. Forest, riparian, and wetland ecosystems are the primary ecosystems on project lands. The forested areas are representative of the Tsuga heterophylla vegetation zone with a prevalence of riparian associated species. The majority of the forested areas are in young and mature successional stages and a significant portion of the project lands are in grass-forb and brush-seedling stages. Old growth exists primarily as scattered remnant trees and in very small stands. Riparian communities, which provide critical habitat for a great number of animal species, have suffered the majority of project-related disruption. Portions of five tributaries to the White River and approximately 2.5 miles of the river are undisturbed and function as an essential wildlife habitat component. Intermittent ponds, seasonally flooded flats, brush and wooded swamps, and marsh areas can be found on project lands and also serve as essential habitat components. Approximately 458 acres of snags have been created by dam operations which provide a unique habitat area for cavity nested birds and other snag-dependent animal species.

A synopsis of key recommendations contained within this report are as follows:

A. FOREST MANAGEMENT:

1. Existing old growth should be maintained. Refer to Page 21.

2. There should be no timber harvesting within the project. If there is limited harvesting, then the cuts should be confined to small patches. Refer to Page 21.

3. Logs should be retained unless they interfere with the project's operation. Refer to Pages 19-20.

B. WETLANDS MANAGEMENT:

1. A comprehensive wetlands inventory should be conducted to provide additional management guidelines. Refer to Pages 21-25.

2. Ownership of that portion of the small marsh which was deeded to the University of Washington should be returned to the project so the area can be managed consistently as a single unit. Refer to Page 25.

3. Consideration should be given to the construction of artificial ponds to provide added and more stable habitat. Refer to Page 25.

4. The interpretive potential of wetlands ecology should be explored further. The construction of a concealed floating dock and bird blinds would greatly enhance the interpretive and educational value of the wetlands. Refer to Page 25.

C. RIPARIAN ECOSYSTEM MANAGEMENT

1. Every attempt should be made to maintain the undisturbed river and stream communities in their present condition. Refer to Pages 26 and 27.

D. SNAG MANAGEMENT

1. The majority of the snags should be left undisturbed. Refer to Page 34.

2. If the selected cutting of snags is deemed necessary, the criteria provided regarding height, diameter, and decay state should be followed in the removal process. Refer to Pages 34-35.

3. Snags located in optimum habitats should be retained. Refer to Page 36.

4. A long-range plan for the gradual replacement of snags should be implemented. Refer to Page 37.

5. Interpretive opportunities should be taken advantage of with the construction of strategically placed bird blinds and the preparation of wildlife identification lists. Refer to Page 38.

E. ELK MANAGEMENT:

1. Population estimates of elk utilizing Mud Mountain Dam winter range should be made. Refer to Page 43.

2. Coordination with the U. S. Forest Service and Washington State Department of Game should be stressed so that a comprehensive elk management plan can be developed. Refer to Page 43.

In conclusion, Mud Mountain Dam has a great wildlife potential and should be carefully managed to preserve the unique and essential aspects of its wildlife habitat.

EXHIBITS

EXHIBIT A

Taxonomy, seasonal occurrence and relative abundance of wildlife species observed at Mud Mountain Dam (*) and inhabiting western Washington in habitats found on project lands.

KEY TO WILDLIFE SPECIES LISTINGS

TAXONOMIC DESIGNATIONS

In many instances, subspecies are found within this area of Western Washington. However, these have not been designated. All wildlife are listed by their genus and species only.

SEASONAL OCCURRENCE

Species occurrence within Western Washington are notated as follows:

R Resident; present all year, although abundance may vary seasonally.

S Summer visitor only; includes spring and fall.

W Winter visitor only; includes spring and fall.

M Migrant; any bird that passes through the state and stays for a time before leaving the boundaries

F Fall only

ABUNDANCE

The relative abundance of species within habitats found at Mud Mountain Dam are recorded. Prevalence between particular habitats may vary; letters indicate greatest level of abundance in one or more habitats.

C Common; often seen or heard in appropriate habitats.

U Uncommon; usually present, but not seen or heard on every visit to appropriate habitat.

R Rare; present in appropriate habitats only in small numbers and seldom seen or heard.

EXHIBIT A

MUD MOUNTAIN DAM WILDLIFE INVENTORY

Taxonomy	Seasonal Occurrence	Relative Abundance
DIDELPHIDAE		
*Virginia oppossum Didelphis virginiana	R	C
SORICIDAE		
*Masked shrew Sorex cinereus hollisteri	R	U
*Trowbridge's shrew Sorex trowbridgei	R	C
*Vagrant shrew Sorex vagrans	R	C
Dusky shrew Sorex obscurus	R	C
Northern water shrew Sorex palustris	R	C
Marsh shrew Sorex bendirei	R	C
TALPIDAE		
*Shrew-mole Neurotrichus gibbsi	R	C
*Townsend's mole Scapanus townsendi	R	C
*Coast mole Scapanus orarius	R	C

Taxonomy	Seasonal Occurrence	Relative Abundance
VESPERTILIONIDAE (CHIROPTERA)		
Little brown bat *Myotis lucifugus*	R	C
Yuma myotis *Myotis yumanensis*	S	C
Keen myotis *Myotis keeni*	S	R
Long-eared myotis *Myotis evotis*	S	U
Fringed myotis *Myotis thysanodes*	S	R
Long-legged myotis *Myotis volans*	R	R
*California myotis *Myotis californicus*	R	C
Silver-haired bat *Lasionycteris noctivagans*	R	U
Big brown bat *Eptesicus fuscus*	R	C
Hoary bat *Lasiurus cinereus*	S	R
Townsend's big-eared bat *Plecotus townsendi*	R	U
LEPORIDAE (LAGOMORPHA)		
*Snowshoe hare *Lepus americanus*	R	C
*Eastern cottontail *Sylvilagus floridanus*	R	C

Taxonomy	Seasonal Occurrence	Relative Abundance
APLODONTIDAE (RODENTIA)		
*Mountain beaver *Aplodontia rufa*	R	C
SCIURIDAE		
*Townsend's chipmunk *Eutamias townsendi*	R	C
*Eastern gray squirrel *Sciurus carolinensis*	R	R
*Chickaree *Tamiasciurus douglasi*	R	C
Northern flying squirrel *Glaucomys sabrinus*	R	C
CASTORIDAE		
*Beaver *Castor canadensis*	R	C
CRICETIDAE		
*Deer mouse *Peromyscus maniculatus*	R	C
*Bushytail woodrat *Neotoma cinerea*	R	C
Heather vole *Phenacomys intermedius*	R	U
Boreal red-backed vole *Clethrionomys gapperi*	R	C
Townsend vole *Microtus townsendi*	R	C
Longtail vole *Microtus longicaudus*	R	C

Taxonomy	Seasonal Occurrence	Relative Abundance
Oregon vole *Microtus oregoni*	R	C
*Muskrat *Ondatra zibethica*	R	C
ZAPODIDAE		
*Pacific jumping mouse *Zapus trinotatus*	R	C
ERETHIZONTIDAE		
*Porcupine *Erethizon dorsatum*	R	C
URSIDAE		
*Black bear *Ursus americanus*	R	C
PROCYONIDAE		
*Raccoon *Procyon lotor*	R	C
MUSTELIDAE		
*Marten *Martes americana*	R	U
*Shorttail weasel *Mustela erminea*	R	U
*Longtail weasel *Mustela frenata*	R	C
*Mink *Mustela vison*	R	C
*River otter *Lutra canadensis*	R	C

Taxonomy	Seasonal Occurrence	Relative Abundance
*Spotted skunk *Spilogale putorius*	R	C
*Striped skunk *Mephitis mephitis*	R	C
CANIDAE		
*Coyote *Canis latrans*	R	C
Common red fox *Vulpes vulpers fulva*	R	C
FELIDAE		
*Mountain lion *Felis concolor*	R	U
*Bobcat Lynx rufus	R	C
CERVIDAE		
*Rocky mountain elk *Cervus canadensis nelsoni*	R	C
*Columbia blacktail deer *Odocoileus hemionus columbianus*	R	C
BIRDS		
GAVIIDAE		
Common loon *Gavia immer*	M	U
PODICIPEDIDAE		
Horned grebe *Podiceps auritus*	M	U

Taxonomy	Seasonal Occurrence	Relative Abundance
Eared grebe *Podiceps nigricollis*	M	C
Western grebe *Aechmophorus occidentalis*	M	C
Pied-billed grebe *Podilymbus podiceps*	R	C
ARDEIDAE		
*Great blue heron *Ardea herodias*	R	C
Green heron *Butorides virescens anthonyi*	R	U
American bittern *Botaurus lentiginosus*	S	C
ANATIDAE		
Whistling swan *Olor columbianus*	M	U
Trumpeter swan *Olor buccinator*	W	U
Canada goose *Branta canadensis*	R	C
*Mallard *Anas platyrhynchos*	R	C
Gadwall *Anas strepera*	W	C
Pintail *Anas acuta*	W	C
Green-winged teal *Anas crecca*	W	C
Blue-winged teal *Anas discors*	S	C

Taxonomy	Seasonal Occurrence	Relative Abundance
American wigeon *Anas americana*	W	C
Northern shoveler *Anas clypeata*	W	C
*Wood duck *Aix sponsa*	R	U
Redhead *Aythya americana*	W	C
Ring-necked duck *Aythya collaris*	W	C
Canvasback *Aythya valisineria*	W	C
Greater scaup *Aythya marila*	M	U
Lesser scaup *Aythya affinis*	W	C
Common goldeneye *Bucephala clangula*	W	C
Barrow's goldeneye *Bucephala islandica*	W	C
Bufflehead *Bucephala albeola*	W	C
Harlequin duck *Histrionicus histrionicus*	R	R
White-winged scoter *Melanitta deglandi*	M	R
Ruddy duck *Oxyura jamaicensis*	W	C
Hooded merganser *Lophodytes cucullatus*	R	U
*Common merganser *Mergus merganser*	R	U

Taxonomy	Seasonal Occurrence	Relative Abundance
Red-breasted merganser Mergus serrator	M	R
CATHARTIDAE		
*Turkey vulture Cathartes aura	S	U
ACCIPITRIDAE		
*Goshawk Accipiter gentilis	R	U
*Sharp-shinned hawk Accipiter striatus	R	U
*Cooper's hawk Accipiter cooperii	R	U
*Red-tailed hawk Buteo jamaicensis	R	C
*Golden eagle Aquila chrysaetos canadensis	R	U
*Bald eagle Haliaeetus leucocephalus alascanus	R	C
Marsh hawk Circus cyaneus hudsonius	R	C
PANDIONIDAE		
*Osprey Pandion haliaeetus carolinensis	S	U
FALCONIDAE		
Peregrine falcon Falco peregrinus	R	R
Merlin Falco columbarius	R	U
*American kestrel Falco sparverius sparverius	R	C

Taxonomy	Seasonal Occurrence	Relative Abundance
TETRAONIDAE		
*Blue grouse *Dendragapus obscurus*	R	C
*Ruffed grouse *Bonasa umbellus*	R	C
PHASIANIDAE		
Bobwhite *Colinus virginianus virginianus*	R	-
*California quail *Lophortyx californicua*	R	-
Mountain quail *Oreotyx pictus*	R	-
Ring-necked pheasant *Phasianus colchicus*	R	C
GRUIDAE		
Sandhill crane *Grus canadensis*	M	U
RALLIDAE		
Virginia rail *Rallus limicola*	R	C
Sora *Porzana carolina*	S	C
Yellow rail *Coturnicops noveboracensis*	F	-
*American coot *Fulica americana*	R	C
CHARADRIIDAE		
*Killdeer *Charadrius vociferus*	R	C

Taxonomy	Seasonal Occurrence	Relative Abundance
Black-bellied plover *Pluvialis squatarola*	M	U
SCOLOPACIDAE		
Common snipe *Capella gallinago delicata*	R	C
*Spotted sandpiper *Actitis macularia*	S	C
Solitary sandpiper *Tringa solitaria*	M	U
Greater yellowlegs *Tringa melanoleuca*	M	C
*Lesser yellowlegs *Tringa flavipes*	M	C
White-rumped sandpiper *Calidris fuscicollis*	M	-
Least sandpiper *Calidris minutilla*	M	C
*Dunlin *Calidris alpina*	W	U
Western sandpiper *Calidris mauri*	M	C
Long-billed dowitcher *Limnodromus scolopaceus*	M.	C
PHALAROPODIDAE		
Wilson's phalarope *Steganopus tricolor*	M	C
Northern phalarope *Lobipes lobatus*	M	C

Taxonomy	Seasonal Occurrence	Relative Abundance
LARIDAE		
Glaucous-winged gull *Laris glaucescens*	W	U
Herring gull *Larus argentatus*	M	U
California gull *Larus californicus*	M	C
Ring-billed gull *Larus delawarensis*	W	C
Mew gull *Larus canus*	W	U
Bonaparte's gull *Larus philadelphia*	M	C
Common tern *Sterna hirundo*	M	C
Black tern *Chlidonias niger*	M	C
COLUMBIDAE		
Band-tailed pigeon *Columba fasciata monilis*	R	C
Rock dove *Columba livia*	R	C
Mourning dove *Zenaida macroura marginella*	S	C
TYTONIDAE		
Barn owl *Tyto alba pratincola*	R	C

Taxonomy	Seasonal Occurrence	Relative Abundance
STRIGIDAE		
*Screech owl *Otus asio*	R	C
*Great horned owl *Bubo virginianus*	R	C
Snowy owl *Nyctea scandiaca*	W	R
*Pygmy owl *Glaucidium gnoma*	R	U
Spotted owl *Strix occidentalis caurina*	R	R
Great gray owl *Strix nebuiosa nebulosa*	R	R
Long-eared owl *Asio otus*	W	U
Short-eared owl *Asio flammeus*	R	C
*Saw-whet owl *Aegolius acadicus*	W	C
CAPRIMULGIDAE		
*Common nighthawk *Chordeiles minor*	S	C
APODIDAE		
Black swift *Cypseloides niger*	S	-
*Vaux's swift *Chaetura vauxi*	S	C

Taxonomy	Seasonal Occurrence	Relative Abundance
TROCHILIDAE		
Anna's hummingbird *Calypte anna*	W	R
*Rufous hummingbird *Selasphorus rufus*	S	C
ALCEDINIDAE		
*Belted kingfisher *Megaceryl alcyon*	R	C
PICIDAE		
*Common flicker *Colaptes auratus*	R	C
*Pileated woodpecker *Dryocopus pileatus*	R	U
Lewis' woodpecker *Asyndesmus lewis*	R	C
*Yellow-bellied sapsucker *Sphyrapicus varius*	R	C
*Hairy woodpecker *Dendrocopus villosus*	R	C
*Downy woodpecker *Dendrocopus pubescens*	R	C
TYRANNIDAE		
Eastern kingbird *Tyrannus tyrannus*	S	C
*Western kingbird *Tyrannus verticalis*	M	C
*Willow flycatcher *Empidonax traillii*	S	C

Taxonomy	Seasonal Occurrence	Relative Abundance
Hammond's flycatcher *Empidonax hammondii*	S	C
*Western flycatcher *Empidonax difficilis*	S	C
*Western wood pewee *Contopus sordidulus*	S	C
*Olive-sided flycatcher *Nuttallornis borealis*	S	C
ALAUDIDAE		
Horned lark *Eremophila alpestris*	R	C
HIRUNDINIDAE		
*Violet-green swallow *Tachycineta thalassina*	S	C
*Tree swallow *Iridoprocne bicolor*	S	C
*Bank swallow *Riparia riparia*	M	C
*Rough-winged swallow *Stelgidopteryx ruficollis*	S	C
*Barn swallow *Hirundo rustica*	S	C
Cliff swallow *Petrochelidon pyrrhonota*	S	C
*Purple martin *Progne subis subis*	S	U

Taxonomy	Seasonal Occurrence	Relative Abundance
CORVIDAE		
*Gray jay *Perisoreus canadensis*	R	C
*Steller's jay *Cyanocitta stelleri*	R	C
*Common raven *Corvus corax*	R	C
*Common crow *Corvus brachyrhynchos*	R	C
PARIDAE		
*Black-capped chickadee *Parus atricapillus*	R	C
*Chestnut-backed chickadee *Parus rufescens*	R	C
Bushtit *Psaltiparus minimus*	R	C
SITTIDAE		
*Red-breasted nuthatch *Sitta canadensis*	R	C
CERTHIIDAE		
*Brown creeper *Certhia familiaris*	R	C
CINCLIDAE		
*Dipper *Cinclus mexicanus*	R	C

Taxonomy	Seasonal Occurrence	Relative Abundance
TROGLODYTIDAE		
House wren *Troglodytes aedon*	S	C
*Winter wren *Troglodytes troglodytes*	R	C
Bewick's wren *Thryomanes bewickii*	R	C
*Long-billed marsh wren *Telmatodytes palustris*	R	C
TURDIDAE		
*American robin *Turdus migratorius*	R	C
*Varied thrush *Ixoreus naevius*	R	C
Hermit thrush *Catharus guttatus*	M	C
*Swainson's thrush *Catharus ustulatus*	S	C
*Townsend's solitaire *Myadestes townsendi*	W	C
SYLVIIDAE		
*Golden-crowned kinglet *Regulus satrapa*	R	C
*Ruby-crowned kinglet *Regulus calendula*	W	C
BOMBYCILLIDAE		
Bohemian waxwing *Bombycilla garrulus*	W	U
*Cedar waxwing *Bombycilla cedrorum*	S	C

Taxonomy	Seasonal Occurrence	Relative Abundance
LANIIDAE		
Northern shrike *Lanius excubitor*	W	U
STURNIDAE		
*Starling *Sturnus vulgaris*	R	C
VIREONIDAE		
*Hutton's vireo *Vireo huttoni*	R	U
*Solitary vireo *Vireo solitarius*	S	C
Red-eyed vireo *Vireo olivaceus*	S	C
*Warbling vireo *Vireo gilvus*	S	C
PARULIDAE		
*Orange-crowned warbler *Vermivora celata*	S	C
Nashville warbler *Vermivora ruficapilla*	M	C
*Yellow warbler *Dendroica petechia*	S	C
*Yellow-rumped warbler *Dendroica coronata*	S	C
*Black-throated gray warbler *Dendroica nigrescens*	S	C
*Townsend's warbler *Dendroica townsendi*	S	C

Taxonomy	Seasonal Occurrence	Relative Abundance
Hermit warbler Dendroica occidentalis	S	U
*MacGillivray's warbler Oporornis tolmiei	S	C
*Common yellowthroat Geothlypis trichas	S	C
*Wilson's warbler Wilsonia pusilla	S	C
PLOCEIDAE		
House sparrow Passer domesticus	R	C
ICTERIDAE		
Western meadowlark Sturnella neglecta	R	C
Yellow-headed blackbird Xanthocephalus xanthocephalus	M	C
*Red-winged blackbird Agelaius phoeniceus	R	C
Northern oriole Icterus gabula bullockii	S	C
Brewer's blackbird Euphagus cyanocephalus	R	C
Brown-headed cowbird Molothrus ater	S	C
THAUPIDAE		
*Western tanager Piranga ludoviciana	S	C

Taxonomy	Seasonal Occurrence	Relative Abundance
FRINGILLIDAE		
*Black-headed grosbeak *Pheucticus melanocephalus*	S	C
Lazuli bunting *Passerina amoena*	S	C
*Evening grosbeak *Hesperiphona vespertina*	R	C
Purple finch *Carpodacus purpureus*	R	C
House finch *Carpodacus mexicanus*	R	C
Common redpoll *Acanthis flammea*	W	U
*Pine siskin *Spinus pinus*	R	C
*American goldfinch *Spinus tristis*	R	C
*Red crossbill *Loxia curvirostra*	R	C
White-winged crossbill *Loxia leucoptera*	W	R
*Rufous-sided towhee *Pipilo erythrophthalmus*	R	C
*Savannah sparrow *Passerculus sandwichensis*	S	C
Vesper sparrow *Pooecetes gramineus*	S	C
*Dark-eyed junco *Junco hyemalis*	R	C
Chipping sparrow *Spizella passerina*	S	C

Taxonomy	Seasonal Occurrence	Relative Abundance
*White-crowned sparrow *Zonotrichia leucophrys*	R	C
Golden-crowned sparrow *Zonotrichia atricapilla*	W	C
White-throated sparrow *Zonotrichia albicollis*	W	R
*Fox sparrow *Passerella iliaca*	R	C
Lincoln's sparrow *Melospiza lincolnii*	M	C
*Song sparrow *Melospiza melodia*	R	C
REPTILES		
ANGUIDAE		
*Northern alligator lizard *Gerrhonotus coeruleus*	R	C
COLUBRIDAE		
*Common garter snake *Thamnophis sirtalis*	R	C
*Western garter snake *Thamnophis elegans*	R	C
*Northwestern garter snake *Thamnophis ordinoides*	R	C

Taxonomy	Seasonal Occurrence	Relative Abundance
AMPHIBIANS		
AMBYSTOMIDAE		
*Northwestern salamander *Ambystoma gracile*	R	C
*Long-toed salamander *Ambystoma macrodactylum*	R	C
*Oregon salamander *Ensatina eschscholtzii*	R	C
SALMANDRIDAE		
*Rough-skinned newt *Taricha granulosa*	R	C
BUFONIDAE		
*Western toad *Bufo boreas*	R	C
HYLINIDAE		
*Pacific treefrog *Hyla regilla*	R	C
RANIDAE		
*Red-legged frog *Rana aurora*	R	C
*Bullfrog *Rana catesbeiana*	R	C

EXHIBIT B

Life form and consumer class of species breeding at Mud Mountain Dam

KEY TO CONSUMER CLASS DESIGNATIONS

Consumer Class 1 (1): This animal consumes Class 1 foods most of the time. These foods are the vegetative parts of terrestrial and aquatic plants, such as leaves, stalks, bark, and twigs. Animals dependent on Class 1 foods are adapted to dealing with large volumes of low quality foods which are regularly available. Many Class 1 consumers are also consuming some Class 2 foods in season.

Consumer Class 2 (2): This animal consumes Class 2 foods most of the time. Class 2 foods are the storage parts of plants, such as roots, bulbs, seeds, tubers, fruits, and nuts. Tree sap, cambium and flower nectar are concentrated Class 2 foods. Annual plants in general have a higher seed production. Animals dependent upon Class 2 foods are adapted for obtaining mid-quality foods which are irregularly or seasonally available. Some Class 2 consumers also take various Class 1 and 3 foods in their diets, especially carrion, a Class 3 food, when available.

Consumer Class 3 (3): Class 3 foods are any other palatable members of the animal kingdom and include eggs and larvae. To survive, carnivores must capture prey of sufficient size to balance the energy expended in hunting and capture efforts. Examples of Class 3 foods: small birds, mammals, reptiles, carrion, insects and all high-protein foods. Animals dependent upon Class 3 foods are adapted for obtaining high-quality foods that are difficult to obtain. Available insect supply is often the most critical factor during nesting season, due to the great nutritional requirements of growing nestling birds being fed by the parents. Some Class 3 consumers that are mammals also take many varieties of Class 2 foods in their diets.

LIFE FORM #1: Reproduces in the water and feeds on the ground or water.

Species	Consumer Class
Amphibians	
Northwestern salamander	3
Long-toed salamander	3
Rough-skinned newt	3
Western toad	3
Pacific tree frog	3
Red-legged frog	3
Bullfrog	3

LIFE FORM #2: Reproduces on the ground around water (or in emergent vegetation, or on floating vegetation), feeds on the ground, in bushes, or in water.

Species	Consumer Class
Reptiles	
Common garter snake	3
Western garter snake	3
Northwestern garter snake	3
Birds	
Pied-billed grebe	3
American bittern	3
Mallard	1, 2
Gadwall	1, 2
Pintail	1, 2
Green-winged teal	1, 2
Blue-winged teal	1, 2
American wigeon	1
Northern shoveler	1, 2
Redhead	1, 2
Ring-necked duck	1, 2
Canvasback	1, 2
Lesser scaup	2, 3
Harlequin duck	3
Ruddy duck	1, 2

Virginia rail	2, 3
Sora	1, 3
Kildeer	3
American coot	1, 3
Common snipe	3
Spotted sandpiper	3
Wilson's phalarope	3
Glaucous-winged gull	3
Ring-necked gull	2, 3
Franklin's gull	2, 3
Black tern	3
Dipper	3
Winter wren	3
Long-billed marsh wren	3
Common yellowthroat	3

LIFE FORM #3: Reproduces on or in cliffs, caves, rim and talus slopes, feeds on the ground or in the air.

Species	Consumer Class
Birds	
Turkey vulture	3
Peregrine falcon	3
Rock dove	2
Black swift	3
Common raven	2, 3
Barn swallow	3
Cliff swallow	3
Mammals	
Bushy-tailed woodrat	2
Bobcat	3

LIFE FORM #4: Reproduces on the ground, without specific water, cliff, rim or talus association, and feeds on the ground.

Species	Consumer Class
Reptiles	
Northern alligator lizard	3

Birds

Marsh hawk	3
Blue grouse	1, 2
Ruffed grouse	1, 2
Bobwhite	1, 2
California quail	1, 2
Mountain quail	1, 2
Ring-necked pheasant	2
Short-eared owl	3
Horned lark	3
Western meadowlark	2, 3
Wilson's warbler	3
Savannah sparrow	2, 3
Vesper sparrow	2, 3
Dark-eyed junco	2

Mammals

Opossum	2, 3
Snowshoe hare	1
Eastern cottontail	1
Elk	1
Black-tailed deer	1

LIFE FORM #5 Reproduces on the ground, feeds in bushes and trees, or in the air.

Species	Consumer Class
Birds	
Common nighthawk	3
Orange-crowned warbler	3
Townsend's solitaire	3
Nashville warbler	3
Lincoln's sparrow	2, 3
Mammals	
Porcupine	1

LIFE FORM #6: Nests in bushes, feeds on the ground, in water, and in the air.

Species	Consumer Class
Green heron	3
Willow flycatcher	3
American robin	3
Swainson's thrush	3
McGillivray's warbler	3
Yellow-headed blackbird	2, 3
Red-winged blackbird	2, 3
Brewer's blackbird	2, 3
Brown-headed cowbird	2, 3
Lazuli bunting	2
Rufous-sided towhee	2
Chipping sparrow	2
White-crowned sparrow	2
Fox sparrow	2, 3
Song sparrow	2, 3

LIFE FORM #7: Nests in bushes, feeds in trees and bushes or in the air.

Species	Consumer Class
Birds	
Bushtit	2, 3
Bewick's wren	3
Yellow warbler	3
American goldfinch	2, 3

LIFE FORM #8: Nests primarily in deciduous trees, feeds in trees and bushes.

Species	Consumer Class
Birds	
Cedar waxwing	2
Northern oriole	2, 3
House finch	2

LIFE FORM #9: Nests primarily in conifers, feeds in trees and bushes, or in the air.

Species	Consumer Class
Birds	
Western flycatcher	3
Olive-sided flycatcher	3
Golden-crowned kinglet	3
Ruby-crowned kinglet	3
Band-tailed pigeon	2
Hutton's vireo	3
Yellow-rumped warbler	3
Black-throated gray warbler	3
Townsend's warbler	3
Western tanager	2
White-winged crossbill	2
Mammals	
Chickaree	2

LIFE FORM #10: Nests in conifers or deciduous trees and feeds in trees or bushes, on the ground, or in the air.

Species	Consumer Class
Goshawk	3
Sharp-shinned hawk	3
Cooper's hawk	3
Merlin	3
Mourning dove	2
Long-eared owl	3
Rufous hummingbird	2, 3
Western kingbird	2, 3
Hammond's flycatcher	3
Western wood peewee	3
Gray jay	2, 3
Steller's jay	2, 3
Common crow	2, 3
Varied thrush	3

Solitary vireo	3
Red-eyed vireo	3
Warbling vireo	3
Black-headed grosbeak	2
Evening grosbeak	2
Purple finch	2
Pine siskin	2
Mammals	
Hoary bat	3

LIFE FORM #11: Nests on very thick branches, feeds on the ground, or in water.

Species	Consumer Class
Birds	
Great blue heron	3
Red-tailed hawk	3
Golden eagle	3
Bald eagle	3
Osprey	3
Great horned owl	3

LIFE FORM #12: Excavates own nest hole, feeds in trees, brush, or in air.

Species	Consumer Class
Birds	
Common flicker	2, 3
Pileated woodpecker	2, 3
Lewis' woodpecker	2, 3
Yellow-bellied sapsucker	2, 3
Hairy woodpecker	3
Downy woodpecker	3
Red-breasted nuthatch	2, 3

LIFE FORM #13: Nests in a hole made by another species or in a naturally occurring hole and feeds on the ground, in water, or in the air.

Species	Consumer Class
Birds	
Wood duck	1, 2
Barrow's goldeneye	3
Bufflehead	3
Hooded merganser	3
Common merganser	3
American Kestrel	3
Barn owl	3
Screech owl	3
Great horned owl	3
Pygmy owl	3
Northern spotted owl	3
Saw-whet owl	3
Vaux's swift	3
Violet-green swallow	3
Tree swallow	3
Purple martin	3
Black-capped chickadee	2, 3
Chestnut-backed chickadee	2, 3
Brown creeper	3
House wren	3
Starling	2
House sparrow	2
Mammals	
Yuma myotis	3
Long-eared myotis	3
Long-legged myotis	3
California myotis	3
Silver-haired bat	3
Big brown bat	3
Northern flying squirrel	2, 3
Racoon	2, 3
Marten	3

LIFE FORM #14: Reproduces in a burrow (underground), and feeds on or under the ground.

Species	Consumer Class
Mammals	
Masked shrew	2, 3
Vagrant shrew	2, 3
Trobridge's shrew	2, 3
Dusky shrew	2, 3
Shrew-mole	2, 3
Townsend's mole	2, 3
Coast mole	3
Mountain beaver	1
Townsend's chipmunk	2
Deer mouse	2, 3
Heather vole	1, 2
Boreal red-backed vole	1, 2
Townsend's vole	1, 2
Longtail vole	1, 2
Oregon vole	1, 2
Pacific jumping mouse	2
Black bear	1, 2, 3
Short-tailed weasel	3
Long-tailed weasel	3
Spotted skunk	2, 3
Striped skunk	2, 3
Coyote	2, 3
Red fox	2, 3

LIFE FORM #15: Reproduces in a burrow (underground) and feeds in the air or in the water.

Species	Consumer Class
Birds	
Belted kingfisher	3
Bank swallow	3
Rough-winged swallow	3
Mammals	
Northern water shrew	3
Marsh shrew	3
Beaver	1, 2
Muskrat	1
Mink	3
River otter	3

EXHIBIT C

Species orientation to successional stages * (22,36)

Species	Grass-forb	Brush Seedling	Pole-Sapling	Young	Mature	Old
MAMMALS						
Oppossum	XO	XO	XO	XO	XO	--
Vagrant shrew	XO	XO	XO	XO	XO	XO
Dusky shrew	--	--	--	XO	XO	XO
Northern water shrew	XO	XO	XO	XO	XO	XO
Coast mole	XO	XO	XO	XO	XO	XO
Little brown myotis	0	0	--	--	0	0
Yuma myotis	--	--	--	--	XO	XO
Long-eared myotis	0	0	0	0	XO	XO
Long-legged myotis	0	0	0	0	XO	XO
California myotis	0	0	--	--	XO	XO
Silver-haired bat	0	0	0	0	XO	XO
Big brown bat	0	0	0	0	XO	XO
Hoary bat	0	0	0	0	0	0
Snowshoe hare	0	XO	XO	XO	X	--
Chickaree	--	--	XO	XO	XO	XO
Northern flying squirrel	--	--	--	XO	XO	XO
Beaver	XO	XO	XO	XO	XO	XO
Deer mouse	XO	XO	XO	XO	XO	XO
Bushytail woodrat	XO	XO	XO	XO	XO	XO
Heather vole	XO	XO	--	--	--	XO
Boreal red-backed vole	--	--	XO	XO	XO	XO
Longtail vole	XO	XO	XO	XO	XO	XO
Muskrat	XO	XO	XO	XO	XO	XO
Porcupine	XO	XO	0	0	0	0
Black bear	0	XO	XO	XO	XO	XO
Raccoon	0	0	--	--	XO	XO
Marten	--	--	0	0	XO	XO
Shorttail weasel	0	XO	XO	XO	XO	XO
Longtail weasel	XO	XO	XO	XO	XO	XO
Mink	XO	XO	XO	XO	XO	XO
River otter	XO	XO	XO	XO	XO	XO
Spotted skunk	XO	XO	XO	--	--	--
Striped skunk	XO	XO	--	--	--	--
Coyote	XO	XO	XO	XO	XO	XO
Red fox	0	XO	XO	XO	XO	XO
Bobcat	--	XO	XO	XO	XO	XO
Rocky mountain elk	0	XO	XO	0	0	0
Blacktail deer	0	XO	XO	--	--	--

X = used for reproduction purposes o = used in feeding

*Species exist on project lands which are not included in the list, as their orientation to successional stages is not known.

Species	Grass-forb	Brush Seedling	Pole-Sapling	Young	Mature	Old
BIRDS						
Eared grebe	XO	--	--	--	--	--
Pied-billed grebe	XO	--	--	--	--	--
Great Blue heron	O	--	--	--	X	--
American bittern	XO	XO	--	--	--	--
Canada goose	XO	XO	XO	XO	XO	--
Mallard	XO	XO	XO	XO	XO	--
Gadwall	XO	XO	XO	XO	XO	--
Pintail	XO	XO	--	--	--	--
Green-winged teal	XO	XO	XO	XO	XO	--
Blue-winged teal	XO	--	--	--	--	--
American wigeon	XO	XO	XO	XO	XO	--
Northern shoveler	XO	--	--	--	--	--
Wood duck	XO	--	--	--	X	X
Redhead	XO	--	--	--	--	--
Ring-necked duck	XO	XO	XO	XO	XO	--
Lesser scaup	XO	XO	--	--	--	--
Barrow's goldeneye	--	--	--	--	X	X
Bufflehead	--	--	--	--	X	X
Harlequin duck	O	O	O	XO	XO	XO
Ruddy duck	XO	--	--	--	--	--
Hooded merganser	--	--	--	--	X	X
Common merganser	--	--	--	--	X	X
Turkey vulture	XO	XO	--	--	--	--
Goshawk	--	O	--	O	XO	XO
Sharp-shinned hawk	--	O	XO	XO	XO	O
Cooper's hawk	O	O	O	XO	XO	O
Red-tailed hawk	O	O	O	XO	XO	XO
Golden eagle	O	O	O	O	XO	XO
Bald eagle	O	O	--	--	XO	XO
Marsh hawk	XO	XO	--	--	--	--
Osprey	--	--	--	--	X	X
Peregrine falcon	XO	XO	XO	XO	XO	XO
Merlin	O	O	O	O	XO	XO
American kestrel	O	O	--	X	X	XO
Blue grouse	O	XO	XO	O	O	O
Ruffed grouse	--	XO	X	O	XO	XO
Bobwhite	O	XO	XO	XO	--	--
California's quail	O	XO	XO	XO	--	--
Mountain quail	O	XO	XO	XO	O	--
Ring-necked pheasant	XO	XO	O	O	O	--
Sandhill crane	XO	O	--	--	--	--
Virginia rail	XO	XO	XO	XO	XO	--
Sora	--	XO	XO	XO	XO	--
American coot	O	XO	XO	XO	XO	--
Killdeer	XO	--	--	--	--	--
Common snipe	XO	--	--	--	--	--
Spotted sandpiper	XO	--	--	--	--	--

Species	Grass-Forb	Brush Seedling	Pole-Sapling	Young	Mature	Old
Solitary sandpiper	XO	XO	XO	--	--	--
Wilson's phalarope	XO	--	--	--	--	--
California gull	XO	XO	--	--	--	--
Ring-billed gull	XO	XO	--	--	--	--
Black tern	XO	--	--	--	--	--
Band-tailed pigeon	O	O	O	--	X	X
Rock dove	XO	--	--	--	--	--
Mourning dove	XO	XO	X	X	X	--
Barn owl	O	O	--	--	XO	XO
Screech owl	O	O	--	X	XO	XO
Great horned owl	O	O	O	XO	XO	XO
Pygmy owl	O	O	O	XO	XO	XO
Great gray owl	O	--	--	XO	O	O
Long-eared owl	O	O	O	XO	XO	XO
Short-eared owl	XO	O	--	--	--	--
Saw-whet owl	--	--	--	X	XO	XO
Common nighthawk	XO	XO	O	O	XO	XO
Black swift	XO	O	--	--	--	--
Vaux's swift	--	--	--	--	XO	XO
Rufous hummingbird	O	XO	X	X	XO	X
Common flicker	O	O	O	XO	XO	XO
Pileated woodpecker	--	--	--	--	XO	XO
Lewis' woodpecker	O	O	--	XO	XO	XO
Yellow-bellied sapsucker	--	--	--	XO	XO	XO
Hairy woodpecker	--	--	--	XO	XO	XO
Downy woodpecker	--	--	--	XO	XO	XO
Eastern kingbird	--	XO	XO	XO	XO	XO
Willow flycatcher	--	O	XO	XO	--	--
Hammond's flycatcher	--	O	O	O	XO	XO
Western flycatcher	--	O	O	XO	XO	XO
Olive-sided flycatcher	O	O	XO	XO	XO	XO
Western wood peewee	--	O	O	XO	XO	XO
Horned lark	XO	--	--	--	--	--
Violet-green swallow	O	O	--	X	X	XO
Tree swallow	O	O	-	X	X	XO
Bank swallow	O	O	--	--	--	--
Rough-winged swallow	O	O	--	--	--	--
Barn swallow	XO	--	--	--	--	--
Cliff swallow	O	O	O	O	O	O
Gray jay	--	O	XO	XO	XO	O
Steller's jay	O	O	XO	XO	XO	XO
Common raven	XO	XO	--	--	--	XO
Common crow	O	O	O	XO	XO	XO
Black-capped chickadee	--	--	XO	XO	XO	XO
Chestnut-backed chickadee	--	--	XO	XO	XO	XO
Bushtit	--	XO	XO	XO	XO	XO
Red-breasted nuthatch	--	--	--	XO	XO	XO
Brown creeper	--	--	--	O	XO	XO
Dipper	XO	XO	XO	XO	XO	XO

AD-A138 521 MUD MOUNTAIN WILDLIFE INVENTORY AND HABITAT ANALYSIS (U) CORPS OF ENGINEERS SEATTLE WA SEATTLE DISTRICT C B BREWER 1979 2/2

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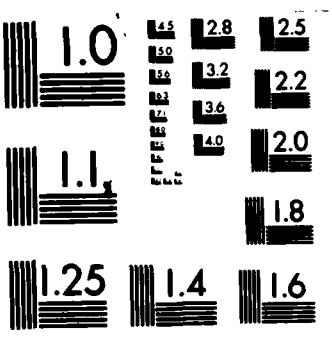

Species	Grass-Forb	Brush-Seedling	Pole-Sapling	Young	Mature	Old
House wren	O	O	XO	X	X	X
Winter wren	--	XO	XO	XO	XO	XO
Long-billed marsh wren	XO	XO	--	--	--	--
American robin	O	XO	XO	XO	XO	XO
Varied thrush	--	O	XO	XO	XO	XO
Hermit thrush	--	--	O	O	XO	XO
Swainson's thrush	--	XO	XO	XO	XO	XO
Townsend's solitaire	XO	XO	XO	XO	XO	XO
Hermit thrush	--	O	O	O	X	X
Golden-crowned kinglet	--	O	O	XO	XO	XO
Ruby-crowned kinglet	--	--	O	O	XO	XO
Cedar waxwing	--	XO	XO	XO	XO	--
Starling	O	O	--	X	X	X
Solitary vireo	--	--	XO	XO	XO	XO
Red-eyed vireo	--	O	XO	XO	XO	XO
Warbling vireo	--	O	XO	XO	XO	XO
Orange-crowned warbler	--	XO	O	O	--	--
Nashville warbler	--	XO	O	O	--	--
Yellow warbler	--	XO	XO	XO	XO	--
Yellow-rumped warbler	--	--	O	XO	XO	XO
Black-throated gray warbler	--	XO	XO	XO	XO	XO
Townsend's warbler	--	--	--	O	XO	XO
MacGillivray's warbler	--	XO	XO	XO	XO	--
Common yellowthroat	O	XO	--	--	--	--
Wilson's warbler	--	XO	XO	XO	XO	--
House sparrow	O	O	--	X	X	X
Western meadowlark	XO	O	--	--	--	--
Yellow-headed blackbird	O	X	--	--	--	--
Red-winged blackbird	XO	XO	--	--	--	--
Northern oriole	--	XO	XO	XO	XO	--
Brewer's blackbird	O	XO	XO	XO	XO	XO
Brown-headed cowbird	O	XO	XO	XO	XO	O
Western tanager	--	O	O	XO	XO	XO
Black-headed grosbeak	O	--	O	XO	XO	XO
Lazuli bunting	O	XO	XO	XO	XO	XO
Evening grosbeak	O	--	O	O	XO	XO
Purple finch	O	O	XO	XO	XO	XO
House finch	O	O	O	XO	XO	O
Pine siskin	O	O	XO	XO	XO	XO
American goldfinch	O	XO	XO	XO	XO	--
Rufous-sided towhee	--	--	XO	XO	XO	XO
Savannah sparrow	XO	O	--	--	--	--
Vesper sparrow	XO	--	--	--	--	--
Bewick's wren	O	XO	--	--	--	--
Dark-eyed junco	XO	XO	XO	XO	XO	XO
Chipping sparrow	O	XO	XO	XO	XO	XO
White-crowned sparrow	XO	XO	XO	XO	XO	XO
Fox sparrow	--	XO	XO	XO	XO	XO
Lincoln's sparrow	XO	XO	O	O	O	--
Song sparrow	--	XO	XO	XO	XO	--

Species	Grass-forb	Brush Seedling	Pole-Sapling	Young	Mature	Old
REPTILES AND AMPHIBIANS						
Common garter snake	XO	XO	XO	XO	XO	XO
Wandering garter snake	XO	XO	XO	XO	XO	XO
Long-toed salamander	XO	--	--	XO	--	--
Western toad	XO	XO	XO	XO	XO	XO
Pacific treefrog	XO	XO	XO	XO	XO	XO

EXHIBIT D

Wildlife use of Riparian and Wetland Ecosystems (4, 37)

Species	Riparian	Wetland	Species	Riparian	Wetland
MAMMALS			MAMMALS (Cont)		
Opossum	XO	XO	Spotted skunk	XO	XO
Vagrant shrew	XO	XO	Striped skunk	XO	XO
Dusky shrew	XO	XO	Coyote	XO	XO
Northern water shrew	XO	XO	Red fox	XO	XO
Marsh shrew	XO	XO	Mountain lion	XO	XO
Shrew-mole	XO	XO	Bobcat	XO	XO
Townsend's mole	XO	XO	Elk	XO	XO
Coast mole	XO	XO	Deer	XO	XO
Little brown bat	XO	XO			
Yuma myotis	XO	XO	BIRDS		
Keen myotis	XO	0			
Long-eared myotis	0	0	Common loon	--	XO
Fringed myotis	--	0	Horned grebe	--	XO
Long-legged myotis	XO	XO	Eared grebe	XO	XO
California myotis	XO	0	Western grebe	--	XO
Silver-haired myotis	0	0	Pied-billed grebe	0	XO
Big brown bat	XO	0	Great blue heron	XO	XO
Hoary bat	0	0	Green heron	--	XO
Townsend's big-eared bat	--	0	American bittern	0	XO
Snowshoe hare	0	XO	Whistling swan	--	0
Eastern cottontail	XO	XO	Trumpeter swan	--	XO
Mountain beaver	XO	XO	Canada goose	XO	XO
Townsend's chipmunk	XO	--	Mallard	XO	XO
Northern flying squirrel	XO	--	Gadwall	XO	XO
Beaver	XO	XO	Pintail	XO	XO
Deer mouse	XO	XO	Green-winged teal	XO	XO
Bushytail woodrat	XO	--	Blue-winged teal	0	XO
Heather vole	XO	XO	American wigeon	XO	XO
Boreal red-backed vole	XO	XO	Northern shoveler	0	XO
Townsend's vole	XO	XO	Wood duck	XO	XO
Longtail vole	XO	XO	Redhead	0	XO
Muskrat	XO	XO	Ring-necked duck	XO	XO
Pacific jumping mouse	XO	XO	Canvasback	--	XO
Porcupine	XO	XO	Greater scaup	--	0
Black bear	XO	XO	Lesser scaup	XO	XO
Raccoon	XO	XO	Common goldeneye	--	0
Marten	--	XO	Barrow's goldeneye	XO	XO
Shorttail weasel	XO	XO	Bufflehead	0	XO
Longtail weasel	XO	XO	Harlequin duck	XO	XO
Mink	XO	XO	Ruddy duck	--	XO
Otter	XO	XO	Hooded merganser	XO	XO

X = used for reproduction O = used for feeding

Species	Riparian	Wetland	Species	Riparian	Wetland
Common merganser	XO	XO	Common flicker	XO	--
Goshawk	XO	0	Lewis' woodpecker	XO	XO
Sharp-shinned hawk	XO	0	Yellow-bellied sapsucker	XO	XO
Cooper's hawk	XO	0	Downy woodpecker	XO	XO
Red-tailed hawk	XO	XO	Eastern kingbird	XO	XO
Golden eagle	0	XO	Western kingbird	XO	XO
Bald eagle	XO	--	Willow flycatcher	XO	XO
Marsh hawk	--	XO	Hammond's flycatcher	XO	0
Osprey	XO	XO	Western flycatcher	XO	0
American kestrel	XO	XO	Western wood peewee	XO	0
Merlin	XO	--	Olive-sided flycatcher	XO	0
Blue grouse	0	--	Violet-green swallow	XO	XO
Ruffed grouse	XO	XO	Tree swallow	XO	XO
Bobwhite	XO	XO	Bank swallow	XO	--
California quail	XO	XO	Rough-winged swallow	XO	--
Mountain quail	XO	XO	Barn swallow	XO	XO
Ring-necked pheasant	XO	XO	Cliff swallow	XO	XO
Sandhill crane	--	XO	Purple martin	--	XO
Virginia rail	XO	XO	Gray jay	0	0
Sora	XO	XO	Steller's jay	XO	0
American coot	XO	XO	Common crow	XO	X
Killdeer	XO	XO	Black-capped chickadee	XO	XO
Common snipe	XO	XO	Chestnut-backed chickadee	XO	--
Spotted sandpiper	XO	--	Bushtit	XO	XO
Greater yellowlegs	--	0	Red-breasted nuthatch	0	--
Lesser yellowlegs	--	0	Brown creeper	--	0
White-rumped sandpiper	--	0	Dipper	XO	--
Least sandpiper	--	0	House wren	XO	XO
Dunlin	--	0	Winter wren	XO	--
Western sandpiper	--	0	Long-billed marsh wren	--	XO
Long-billed dowitcher	--	0	Robin	XO	XO
Wilson's phalarope	--	XO	Swainson's thrush	XO	0
Northern phalarope	--	0	Hermit thrush	XO	0
California gull	XO	0	Townsend's solitaire	XO	0
Ring-billed gull	XO	0	Golden-crowned kinglet	0	0
Black tern	0	XO	Ruby-crowned kinglet	XO	XO
Mourning dove	XO	X	Bohemian waxwing	0	--
Barn owl	XO	XO	Cedar waxwing	XO	XO
Screech owl	XO	XO	Northern shrike	0	0
Great horned owl	XO	0	Starling	XO	XO
Pygmy owl	XO	XO	Solitary vireo	XO	0
Great gray owl	XO	--	Red-eyed vireo	XO	XO
Long-eared owl	XO	XO	Warbling vireo	XO	0
Short-eared owl	--	XO	Orange-crowned warbler	XO	XO
Saw-whet owl	XO	XO	Nashville warbler	XO	XO
Vaux's swift	0	--	Yellow warbler	XO	--
Rufous hummingbird	XO	--	Yellow-rumped warbler	XO	XO
Belted kingfisher	XO	--	Black-throated gray warbler	0	--

Species	Riparian	Wetland
Townsend's warbler	XO	0
MacGillivray's warbler	XO	XO
Common yellowthroat	XO	XO
Wilson's warbler	XO	XO
House sparrow	XO	XO
Western meadowlark	--	XO
Yellow-headed blackbird	--	XO
Red-winged blackbird	--	XO
Northern oriole	XO	XO
Brewer's blackbird	XO	XO
Brown-headed cowbird	XO	XO
Western tanager	XO	XO
Black-headed grosbeak	0	0
Lazuli bunting	XO	--
Evening grosbeak	0	0
Purple finch	0	0
House finch	XO	XO
Common redpoll	0	0
Pine siskin	0	0
American goldfinch	XO	XO
Rufous-sided towhee	XO	XO
Savannah sparrow	--	XO
Dark-eyed junco	XO	0
Chipping sparrow	XO	XO
White-crowned sparrow	XO	0
Golden-crowned sparrow	XO	0
Fox sparrow	0	0
Lincoln's sparrow	XO	0
Song sparrow	XO	XO

Species	Riparian	Wetland
REPTILES AND AMPHIBIANS		
Northwestern salamander	--	XO
Long-toed salamander	XO	0
Rough-skinned newt	--	XO
Western toad	0	XO
Pacific treefrog	0	XO
Red-legged frog	0	XO
Bullfrog	--	XO

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This intern report was read and accepted by a staff member at:

Agency: Department of the Army
Seattle District, Corps of Engineers
Address: P. O. Box C-3755
Seattle, Washington 98124

The Western Interstate Commission for Higher Education

The Western Interstate Commission for Higher Education (WICHE), located in Boulder, Colorado, is a compact organization serving regional higher education needs in the 13 western states: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. During its 25-year history, it has provided projects in higher education in a number of areas: professional student exchanges, health and human services, criminal justice, minority programs, and student internships.

The WICHE Intern Program

The WICHE Intern Program is a service-learning/student internship program for students in the 13 western states. The program provides work experiences for upper division undergraduate, and graduate and professional students. The internship involves a fulltime commitment for a period of 12-36 weeks in an approved agency, some with credit, all with paid stipends. The fields for student internships have been varied, with special efforts by WICHE to develop student experiences in areas traditionally lacking in practicum opportunities: humanities, multicultural education, economic development, energy, rural education, and handicapped education. The criteria for approval of a student internship "project" is that students perform professional-level work for the agency in which they are placed, most times completing a professional report "commissioned" by the sponsoring agency.

Services of the WICHE Intern Program

Although the Intern Program provides internships in a variety of fields contingent upon the sources of its funding, the services it provides are consistent in all internship projects:

- We locate the sponsoring agencies and work with them to develop projects for students;
- We recruit qualified students for the agency's selection of final intern(s);
- We assume responsibility for the accounting/bookkeeping functions which relate to internships, i.e., payment of weekly stipends, intern travel reimbursements, costs of publishing reports, liability insurance for students;
- We assist students to locate resource materials for the conduct of their project;
- We print intern reports and distribute them to agencies, depository libraries in the West, and others interested in reports;
- We evaluate the intern experience and conduct follow-ups with sponsors.

For further information, write WICHE Intern Program, WICHE, P.O. Drawer 'P', Boulder, Colorado 80302 or call (303) 443-6144.

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